ICS ELECTRONICS CORPORATION

Model 4885A
RS-232 to IEEE 488 Controller
Instruction Manual

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RS232 to IEEE488 Controller
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ICS ELECTRONICS CORPORATION

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1

Specifications

1.1 DESCRIPTION

The 4885A Controller provides a means of controlling an IEEE 488 Bus System from any computer's RS-232 I/O port or from any other RS-232 serial command source. The 4885A Controller accepts instructions in a high level language and generates the command signals and character codes necessary to carry out the instructions on the IEEE 488 Bus. Data from devices is then transmitted back to the computer or controlling source over the RS-232 data path. The 4885A's serial I/O connector provides a full set of RS-232 signals to interface to a modem, and a second set of RS-232 signals for a terminal. 20mA current loop signals are also provided for a modem and a teletype.

The Controller contains all of the logic and intelligence necessary to act as a Bus Controller by interpreting the high level language commands sent over the RS-232 data path. The 4885A Controller is capable of addressing any device on the Bus, sending and/or receiving data and generating the universal and addressed Bus commands. The 4885A Controller can also be used to accept service requests, conduct a serial poll to determine which device requested service and conduct a parallel poll to obtain device status.

The Controller's 488 Bus Connector is compatible with the electrical and physical requirements of IEEE Specification 488-1975. The 488 Bus uses eight lines for data and eight lines for control and handshake functions. All data is transferred as parallel eight bit characters under the direction of a controlling device, in this case the 4885A Bus Controller. The 488 Bus concept allows many different instruments to be quickly connected together to form a working system without the use of multiple, special purpose interfaces.

1.2 DETAIL SPECIFICATIONS

The following specifications apply in general to all 4885A series Controllers. Exact specifications for your model may be found by comparing its model number against the listed specifications.

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[1] Teletype is a registered trademark of Teletype Corporation, Skokie, Illinois.

1.2.1. Model Number Designation

4885 - XX — General Model number

Option Code

-01	Special crystal
-03	Special paint
-04	No logo on front panel
-06	Modified program tables
-07	Special program
-J	100/200Vac transformer

RS-232 Bus Controller Model Number

Figure 1-1 Model 4885 RS-232 to IEEE 488 Bus Controller

1.2.2 IEEE 488 Bus Interface Functions

Controller subsets C1 thru C4 and C25 which includes: source and acceptor handshakes, single and extended addresses, service request, remote enable, device trigger, device clear, serial poll and parallel poll.

The Controller enables messages to be transferred from:

a.) Controller to Device(s)

b.) Device to Controller

The Controller does not enable messages to be sent from device to device nor pass or take control of the bus from another controller.

1.2.3 IEEE 488 Bus Specifications

Form	Sixteen lines, eight data and eight for control status messages. Data transfer is byte serial using 3 wire handshake. IEEE 488 command and address messages shown in Table 1-1.
Interface	Driver and receiver circuits TTL compatible. Outputs sink 40mA and drive over 20 meters of cables.
Address Capability	Address 31 Talk/Listen single addressed devices (addresses 0 thru 30) and 961 extended addressed devices.

1.2.4 Bus Message Format

Format established by user's selection of commands and data to be transmitted over the Bus. There are no character restrictions except those necessary to delineate the commands themselves. Listen address 07 should be avoided to preclude a possible conflict with the use of the single quote mark delineators used in the CMD instruction.

The 4885A operates with both ASCII and binary characters on the Bus. The 4885A normally terminates ASCII character messages with a CR, LF and the EOT line while using just the EOT line for binary data. The 4885A also normally recognizes a CR, a LF or the EOT line as the end of an ASCII message and the EOT line or a preset count as the end of a binary message. Note that these message terminators can be changed with the format command to accommodate different instruments.

1.2.5 Command Sequence

The 4885A has no internal restrictions on the users command sequence with the following exceptions:

1. Format statements must preceed the statements where they are referenced.

2. An ONI statement must preceed any EIR commands to avoid incorrect SRQ responses.

3. The 4885A stores multiple commands in its input command buffer and executes them in the order they were received. Therefore, it is up to the user to employ common sense and arrange the commands in the order they are required to operate devices on the Bus. Missing commands, unexecutable commands or commands given in the reverse order could hang up the Bus and therefore the controller.

1.2.6 Commands and Command Format

The 4885A Bus Controller accepts, interprets and acts upon high level language commands received via its serial 1/O port. All commands are started by a unique character (shown as @ in Table 1-2) and ended by a unique terminating character (shown as CR in Table 1-2). While the standard units use @ and CR for these characters they are easily altered by the user in the field.

The 4885A accepts both Bus commands and internal function commands. Bus commands and their reponses are listed in Table 1-2. Internal commands and their responses are listed in Table 1-3.

1.2.7 Data Storage

Internal 4885A Buffers have following storage capacity in characters:

Buffer	Maximum Message Length (in characters)	Used by following Instructions
Interrupt response message	24	ONI
Command input buffer	256	All
Data reply buffer	no limit	RED,RDB RDS&POL

1.2.8 Serial I/O

RS-232 Output	Meets E1A RS-232C specifications for AA, AB, BA, BB, CA, CB, CC, CD and CF signals. 4885A RS-232 control signals programmed as data terminal. Coupler raises CA (request-to-send) and checks for a valid CB (clear-to-send) signal and high CC (data-set-ready) and CF (received-signed-detector) signals before outputting data. Coupler drops CD (data-terminal-ready) when received, data buffer is full.
Teletype Output	Full duplex interface for a 20mA circuit paralleling the modem and the terminal RS-232 I/O. Teletype keyboard sensing circuit uses + and - 12 Vdc.
Data Character	Internally switch selectable as: • Even, odd or not parity • 1 or 2 stop bits • 5, 6, 7 or 8 bits

1.2.9 Physical Description

CONTROLS

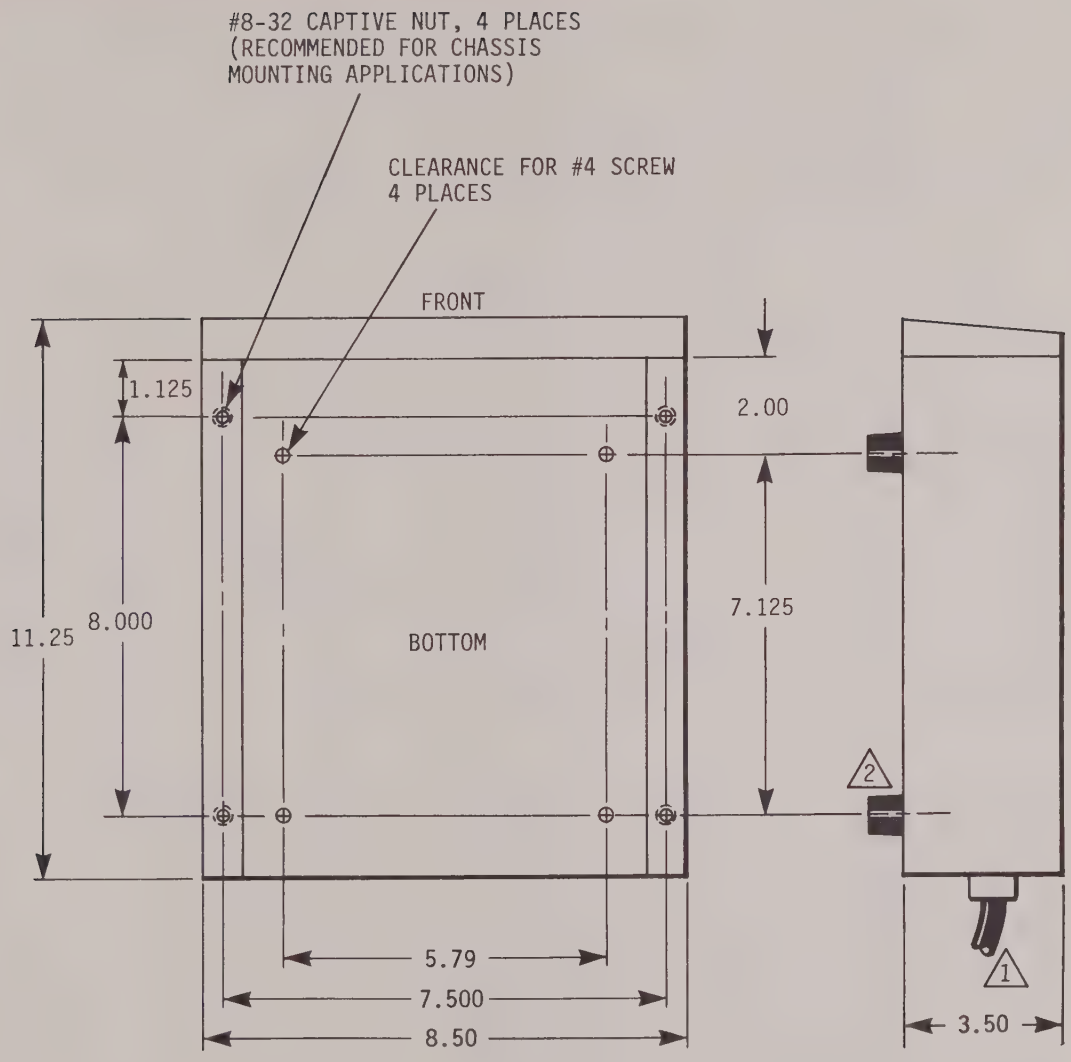
POWER	Energizes unit.
RESET	Clears internal logic and buffers.
STANDBY	Inhibits Controller from responding to command messages.
Address Switch	Rear panel switch assembly used to set the 4885A escape character. Factory preset to the AT character (@).
Baud Rate Switch	Rear panel assembly includes five frequency setting switches, a SOURCE selection switch, CR/CRLF switch, and the MUTE switch.
Power Select	Rear Panel slide switch selects 115 or 230Vac power.

INDICATORS

POWER	Illuminates when power is on.
READY	Illuminated when RS-232 control lines (CC and CF) are true (high) and Bus lines (ATN, EOI and IFC) are off (high).
TALKING	Illuminated when 4885A is outputting data to the Bus
LISTENING	Illuminated when 4885A is inputting data from the Bus

DESCRIPTION

Dimensions	8.5 in. (21.6 cm) wide x 3.5 in. (8.9 cm) high x 11.25 in. (28.6cm) deep excluding connectors.
Weight	6 pounds (2.7 kgm)
Connectors	RS-232 Interface, Cinch DB-25S. IEEE 488 Bus Interface, Amphenol 57-20240 with metric lock nuts.
Power Requirements	115 or 230Vac $\pm$ 10%, 48-62Hz, 35 watts maximum std. 100 or 200Vac $\pm$ 10%, 48-62Hz, (-J option) Fuse - 3AG, 1 ampere for 100-115 Vac - 3AG, 1/2 ampere for 200-230Vac
Temperature	$-0^{\circ}C$ to $+50^{\circ}C$ operating, $-20^{\circ}C$ to $-70^{\circ}C$ non-operating.



Notes: 1. Six foot long removable cord
2. Removable feet

Figure 1-2 - 4885A Outline Dimensions

TABLE 1-1 IEEE 488 COMMAND AND ADDRESS MESSAGES

ASCII — IEEE 488 BUS MESSAGES (COMMANDS AND ADDRESSES) HEX CODES

MSD / LSD	0		1		2		3		4		5		6		7	
	ASCII	MSG	ASCII	MSG	ASCII	MSG[1]	ASCII	MSG[1]	ASCII	MSG[1]	ASCII	MSG[1]	ASCII	MSG	ASCII	MSG
0	NUL		DLE		SP	00	0	16	@	00	P	16	`		p	
1	SOH	GTL	DC1	LLO	!	01	1	17	A	01	Q	17	a		q	
2	STX		DC2		"	02	2	18	B	02	R	18	b		r	
3	ETX		DC3		#	03	3	19	C	03	S	19	c		s	
4	EOT	SDC	DC4	DCL	$	04	4	20	D	04	T	20	d		t	
5	ENQ	PPC	NAK	PPU	%	05	5	21	E	05	U	21	e		u	
6	ACK		SYN		&	06	6	22	F	06	V	22	f		v	
7	BEL		ETB		'	07	7	23	G	07	W	23	g		w	
8	BS	GET	CAN	SPE	(	08	8	24	H	08	X	24	h		x	
9	HT	TCT	EM	SPD	)	09	9	25	I	09	Y	25	i		y	
A	LF		SUB		*	10	:	26	J	10	Z	26	j		z	
B	VT		ESC		+	11	;	27	K	11	[	27	k		(	
C	FF		FS		,	12	<	28	L	12	\	28	l		|	
D	CR		GS		-	13	=	29	M	13	]	29	m		)	
E	SO		RS		.	14	>	30	N	14	^	30	n		~	
F	SI		US		/	15	?	UNL	O	15	_	UNT	o		DEL	

MEANING DEFINED BY PCG CODE

MEANING DEFINED BY PCG CODE

ADDRESSED COMMAND GROUP

UNIVERSAL COMMAND GROUP

LISTEN ADDRESS GROUP

TALK ADDRESS GROUP

SECONDARY COMMAND GROUP

PRIMARY COMMAND GROUP (PCG)

Notes:

1. Device Address messages shown in decimal
2. Message codes are:
   DCL — Devices Clear
   GET — Device Trigger
   GTL — Go to Local
   LLO — Local Lockout
   PPC — Parallel Poll Configure
   PPU — Parallel Poll Unconfigure
   SDC — Selected Device Clear
   SPD — Serial Poll Disable
   SPE — Serial Poll Enable
3. ATN off, Bus data is ASCII; ATN on, Bus data is an IEEE MSG.

TABLE 1-2 CONTROLLER BUS COMMANDS AND RESPONSES

@WRT AA,[2] D...D CR	WRITE - Controller selects device AA as a listener and transmits data characters D. . .D to that device until a carriage return is sensed. The Controller then outputs a CR, LF and the unlisten command.
@WTB AA, D CR	WRITE BYTE - Controller addresses device AA as a listener and outputs data character(s) D to the device. The unlisten command is not sent by the Write Byte instruction.
@RED AA CR	READ - Controller inputs data from device AA until it detects a CR or a LF and transmits the data to the computer. The controller outputs an untalk command to the device.
@RDB AA CR	READ BYTE - Controller inputs 1 or more data characters from device AA and transmits them to the computer. The untalk command is not sent by the Read Byte instruction.
@FMT F, NB, NT, Z CR	FORMAT - Stores one of 6 formats ($0 \leq F \leq 5$) in the controller's memory for later use by the read and write commands. The F field is the format number. The B field sets the number of bytes read during the RDB command. The T field establishes the message terminators for the RTD command. The Z field inhibits the addition of CR and LF to the Bus and data outputs during WRT, RED and RDB instructions. The default format, #0, is initialized to 1 byte, CR, LF and EOT terminators for RED, and to add CR LF to the WRT, RED and RDB messages.

[2] Address AA has the following formats

AA - Two digits 00 thru 30 for single address devices.

AAA - Four digits, 0000 thru 3030 for extended address devices.

AA.F or AAAA.F-Specifies a format F, 0 thru 5, for inputting or outputting data.

Controller defaults to format 0 when no format is specified.

@CMD 'C...C','D..D' CR	COMMAND - Controller transmits characters C...C to Bus as Bus commands and D...D to the Bus as data. Controller recognizes CR outside of the single quotation marks as end of the command. The quotation marks and comma are not passed on to the Bus.
@TRG AA CR @TRG CR	DEVICE TRIGGER (or GET) - Controller addresses device AA as a listener and outputs the GET command to it. If the address is not specified, the controller outputs the GET command to all devices on the Bus.
@CLI CR	CLEAR INTERFACE - Controller pulses the interface clear command to clear all devices and regain control of the system.
@CLR AA CR @CLR CR	DEVICE CLEAR - Controller addresses device AA as listener, and send the selected device clear (SDC) command followed by the unlisten command. If the address is not specified, the controller outputs the universal device clear (DLC) command to all devices on the Bus.
@LCL AA CR @LCL CR	GO TO LOCAL - Controller addresses device AA as a listener and sends the go to local (GTL) command followed by the unlisten command. If the address is not specified, the Controller clears remote message. (Resets the REN Bus line.)
@ REM CR	REMOTE ENABLE - Controller sends remote enable message to all devices. (Sets the REN Bus line on).
@DIR CR	INTERRUPT DISABLED - Disables controller from responding to an SRQ interrupt.
@EIR CR	INTERRUPT ENABLE - Enables controller to sense an SRQ interrupt. Controller must be reenabled after each interrupt is serviced.
@ONI 'D...D' CR	ON INTERRUPT - Controller stores character string D...D for transmission to the computer when an SRQ is sensed. Character string must end with quotation marks followed by a carriage return, and may not exceed 18 characters.

@RDS AA CR
@RDS CR

READ STATUS - Controller inputs the serial poll response from device AA and passes it on to the computer. The device is left in the untalk mode. If the address is not specified, the controller inputs the Bus signal byte and passes it on to the computer.

Serial Response Bit Meanings

Bit	Bus Data	Bus Signals
B0	D1	DAV
B1	D2	NRFD
B2	D3	NDAC
B3	D4	IFC
B4	D5	SRQ
B5	D6	REN
B6	D7	EOT
B7	D8	ATN

@POL CR

POLL - Controller conducts a parallel poll of those devices on the Bus and returns the Bus data byte to the computer. Data byte bit values are the same as shown for RDS Data.

@POLC AA, SS CR

PARALLEL POLL CONFIGURE -Controller addresses device AA as a listener, sends it the parallel poll configure (PPC) command followed by the parallel poll enable (PPE) command. SS selects the response bit and polarity and is the decimal equivalent of the 4 lsb's in the PPE command. Valid SS numbers are 00 thru 15.

@POLU AA CR
@POLU CR

PARALLEL POLL UNCONFIGURE -Controller addresses device AA as a listener and sends it the parallel poll configure (PPC) command followed by the parallel poll disable (PPD) command. If no address is specified, the controller outputs the parallel poll unconfigure (PPU) command to all devices on the Bus.

TABLE 1-3 CONTROLLER INTERNAL COMMANDS AND RESPONSES

@CTS CR	Selects the terminal as the command source.
@CMS CR	Selects the modem/computer as the command source. (Power ON condition).
@CTO CR	Enables the controller to output data to the terminal as well as to the computer in the CMS mode. Use @CMS to cancel the terminal output.
@CMO CR	Enables the Controller to output data to the modem/computer as well as to the terminal in the CTS mode. Use @CTS to cancel the terminal output.
@@@	Resets the controller and outputs an IFC pulse to the Bus. Overrides all other commands and Bus conditions. CR is not required to terminate this command.

2

Installation

2.1 UNPACKING AND INSPECTION

If shipping carton or instrument is damaged, call carrier immediately, inspect Controller for damage (scratches, dents, etc.). If unit is damaged or fails to meet specifications, notify ICS Electronics or your local sales representative immediately. Retain shipping carton and packing material for carrier's inspection. ICS will make arrangements for unit to be repaired or replaced without waiting for claim against carrier to be settled.

2.2 BENCH OPERATION

The Bus Controller is ready for bench operation when shipped with the exception of setting the rear panel escape and baud rate switches. See Section 3.1 for ESCAPE switch, for Baud rate, CR/CRLF, MUTE and SOURCE switch setting instructions. See section 3.4 for PROM program table modification instructions.

The unit is equipped with four feet for setting on other instruments. While capable of operation at elevated room temperatures, for best stability and long life, do not place the unit where it will be subjected to undue temperature rises.

2.3 RACK INSTALLATION

Rack installation is feasible only if a rack mounting kit was shipped with the instrument. To convert the unit for rack mounting, do the following:

a. Remove feet and cover.

b. Slide the 4885A in the rack mounting kit from the front until front bezel is just outside of rack mount assembly.

c. Turn rack mount kit on its side. Line up 4885A case feet mounting screws with those in the rack. Use furnished screws to unfasten unit in place.

d. Repeat steps a through c if a second unit is to be installed in the rack mount assembly. If a second unit is not to be installed mount the dummy front panel in its place.

e. Place cover on top of rack and use furnished screws to fasten cover in place.

f. Install rack mount assembly in rack and attach cables to unit(s).

g. To service or adjust units, reverse steps f through c.

CAUTION

ALWAYS REMOVE POWER FIRST BEFORE WORKING UNITS

2.4 POWER CONNECTIONS

The unit may be operated from either 115 or 230Vac, 50 or 60Hz power. A rear panel slide switch selects 115 or 230Vac operation. The unit is equipped with a three prong international power socket which accepts 115Vac American style power cords or 230Vac European style power cords.

Unit is equipped with a 1.0 ampere fuse for 115Vac use. Change fuse to 0.5 ampere for use with 230Vac power.

An optional 100/200Vac transformer is available for use in Japan and other countries.

2.5 IEEE 488 BUS CONNECTIONS

The unit is equipped with a 24-pin connection, J1, which mates with any 488 Bus Cable. All pin numbers and signals characteristics are per IEEE Specification, 488-1975. Signal - pin assignments are listed for reference purposes in Table 2-1.

TABLE 2-1 488 BUS CONNECTIONS (J1)

Pin	Signal	Pin	Signal
1	DI01	13	DI05
2	DI02	14	DI06
3	DI03	15	DI07
4	DI04	16	DI08
5	EOI	17	REN
6	DAV	18	DAV Ret
7	NRFD	19	NRFD Ret
8	NDAC	20	NDAC Ret
9	IFC	21	IFC Ret
10	SRQ	22	SRQ Ret
11	ATN	23	ATN Ret
12	Shield	24	Ground

2.6 SERIAL RS-232 (20 mA) CONNECTIONS

The 4885A Controllers have a 25 pin, EIA RS-232 compatible connector, J2, that contains all of the serial I/O signals listed in Table 2-2. Connector J2 is a Cinch DB-25S connector with female pins. There are four kinds of signals on connector J2:

1. RS-232 data and control signals to interface to a modem.
2. RS-232 data signals and limited control signals for a terminal.
3. 20mA current loop signals to interface to a minicomputer.
4. 20mA current loop signals to interface to a 20mA teletype.

The 4885A Controller can be connected to a computer or other data source in the following ways. The numbers shown in parenthesis are paragraph numbers that describe the appropriate cable design.

1. Directly to any computer's RS-232 I/O port (2.6.2).
2. Indirectly to a computer thru an RS-232 compatible modem (2.6.3).
3. In a 'T' configuration between a computer and a terminal (2.6.1).
4. In a 'T' configuration between a modem and a terminal (2.6.1).
5. To a terminal (2.6.4).
6. To a computer's 20mA I/O port (2.6.6).
7. To a teletype (2.6.7).
8. In a 'T' configuration between a computer and a teletype (2.6.5).

Note that the 4885A Controller's RS-232 handshaking signals are designed to interface to a modem. Exercise caution when interfacing the 4885A to another type of device to assure that the RS-232 handshaking lines are properly connected. The handshaking line functions are:

CA - 4885A sets request-to-send signal on at the start of an output message and off at the end of a message. CA only sets on if CC and CF are high and CB is low.

CB - Clear-to-send signal must follow CA high for the 4885A to output data. Receiving device may pull CB low to stop the data transmission. If CB is not used, tie CA to CB.

CC
CF - Data-set-ready and Receive-signal-detector are checked for the READY light, before setting CA, and both must be high for the 4885A to output data. The receiving device may pull either line low to stop the data transmission. Pull high or tie to CD if not used.

CD - Data-Terminal-ready is normally high and is set low four characters before the 4885A's input buffer is full. Note that the 4885A will accept but not store serial data when the input buffer is full.

TABLE 2-2 J2 SERIAL I/O PIN ASSIGNMENTS

EIA Code	Signal/Function	Data/Signal Directions (in) (out)	Pin/No.
AA	Chassis ground	-	1
BA	Transmitted Data to Modem	→	2
BB	Received Data from Modem	←	3
CA	Request-to-Send	→	4
CB	Clear-to-Send	←	5
CC	Data Set Ready	←	6
AB	Signal ground	-	7
CF	Signal Detected	←	8
	-		9
	TTY KYBD -	←	10
	TTY ENA JUMPER	-	11
	TTY ENA JUMPER	-	12
BA'	Terminal Keyboard, TTY KYBD+	←	13
	-		14
	TTY Printer +	→	15
	TTY Printer -	→	16
BB'	Received data to Terminal	→	17
CD'	Terminal DTR	←	18
CA'	Terminal RTS	←	19
CD	Data Terminal Ready	→	20
	CPU 20mA IN +	←	21
	CPU 20mA IN -	←	22
	CPU 20mA switch OUT +	→	23
	TTY KYBD + Bias	-	24
	CPU 20mA switch OUT	→	25

2.6.1 Connection between a computer and a terminal

The 4885A Controller can be connected between a computer and its terminal by fabricating a 'T' cable similar to the ICS RS-232 'T' cable, 12038, shown in figure 2-1. The 'T' cable connects all the EIA non prime signals listed in Table 2-2 to the computer and all the prime EIA signals to the terminal. RS-232 control signals, CB, CC and CF, are connected to all three devices. The computer raises CB to acknowledge the 4885's CA (request - to send), signal and also outputs the RS-232 status signals, CC and CF.

The above instructions are also used to connect a 4885A between a modem and a terminal.

2.6.2 Connection to a Computer's RS-232 Port

The 4885A Controller can be connected directly to a computer's RS-232 I/O port by fabricating a cable similar to part of the 'T' cable shown in figure 2-1. Wire per the Modem and 4885A pin number columns. Limit the cable length to fifty feet. Check the BA and BB signal directions with your computer's hardware manual to assure proper data flow. Program the computer's RS-232 I/O port to operate like a modem. Adjust both the computer and 4885A for the same baud rate and character format.

2.6.3 Connection to a Modem

The 4885A Controller can be connected to a Modem by fabricating a portion of the 'T' cable shown in figure 2-1. Use only the Modem and 4885A pin number columns when fabricating the cable and limit the length to fifty feet.

2.6.4 Connection to an RS-232 Terminal

There are two possible connections that can be used to connect the 4885A to a RS-232 Terminal. If the terminal is connected to pins 2 and 3 on J2, it replaces the modem or computer input. The 4885A Controller will operate normally if the RS-232 handshake signals are properly connected to the terminal or tied back to the 4885A. To tie the handshake signals back, connect CA to CB and CC and CF to CD.

The second method of connecting a 4885A to a terminal is to use the prime EIA data signals on pins 13 and 17 of J2. The 4885A's EIA non-prime handshake signals should be tied back, and the rear panel SOURCE switch should be moved to the up position. The 4885A Controller should also be sent the @CTS command after power turn on or using the @@@ reset command to convert the 4885A for operation with the terminal. Figure 2-2 shows a typical 4885A-to-Terminal cable assembly.

2.6.5 Connection between a computer and a teletype

The 4885A Controller can be connected in a 20mA current loop between a computer and a teletype by fabricating a cable similar to the ICS TTY 'T' Cable, 12120, shown in figure 2-3. The TTY 'T' cable connects the computer's 20mA output signal to an optical isolator which parallels the RS-232 BB data input and to an isolated floating transistor which acts as the TTY keyboard switch. The cable also connects the 4885A's 20mA output to the TTY printer and the switch sensing circuit to the TTY keyboard. In addition, the cable contains jumpers which condition the unused EIA RS-232 handshake signals so the 4885A can send and receive data.

Prior to connecting the 4885A to the current loop, check the teletype/computer to verify that the current loop is a 20mA loop and that it uses less than 30 volts to sense the teletype keyboard's open contact position. Cable length between the teletype and the 4885A should not exceed 20 feet. Set the 4885A's baud rate and character format to match the teletype's 110 baud rate and 2 stop bit character format.

EIA CODE	SIGNAL/ FUNCTION	MODEM PIN No.	4885A-J2 PIN No.	TERMINAL PIN No.
AA	CHASSIS GND	1	1	1
BA	TRANS DATA TO MODEM	2	2	-
BB	RCVD DATA FROM MODEM	3	3	-
CA	REQ-TO-SEND	4	4	-
CB	CLR-TO-SEND	5	5	5
CC	DATA-SET-RDY	6	6	6
AB	SIGNAL GND	7	7	7
CF	SIGNAL DET	8	8	8
CD	TERM RDY	20	20	-
BA'	TERM TRANS DATA	-	13	2
BB'	TERM RCVD DATA	-	17	3
CA'	TERM REQ-TO-SEND	-	19	4
CD'	TERM TERM RDY	-	18	20

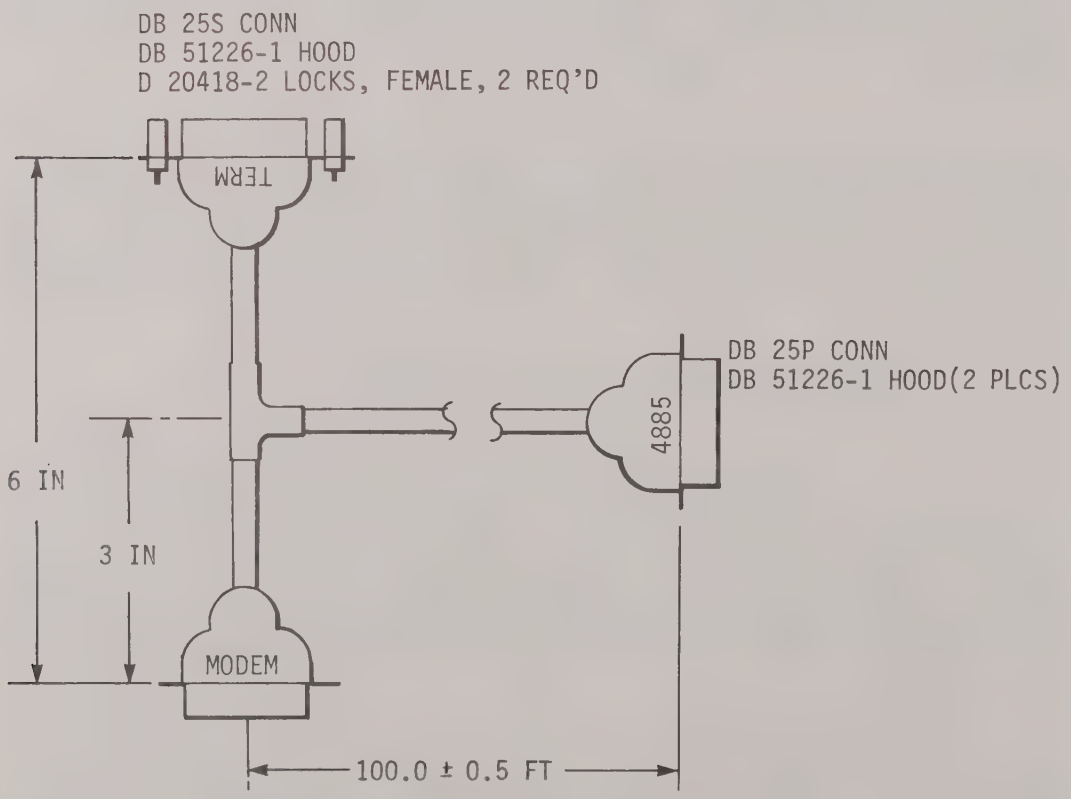
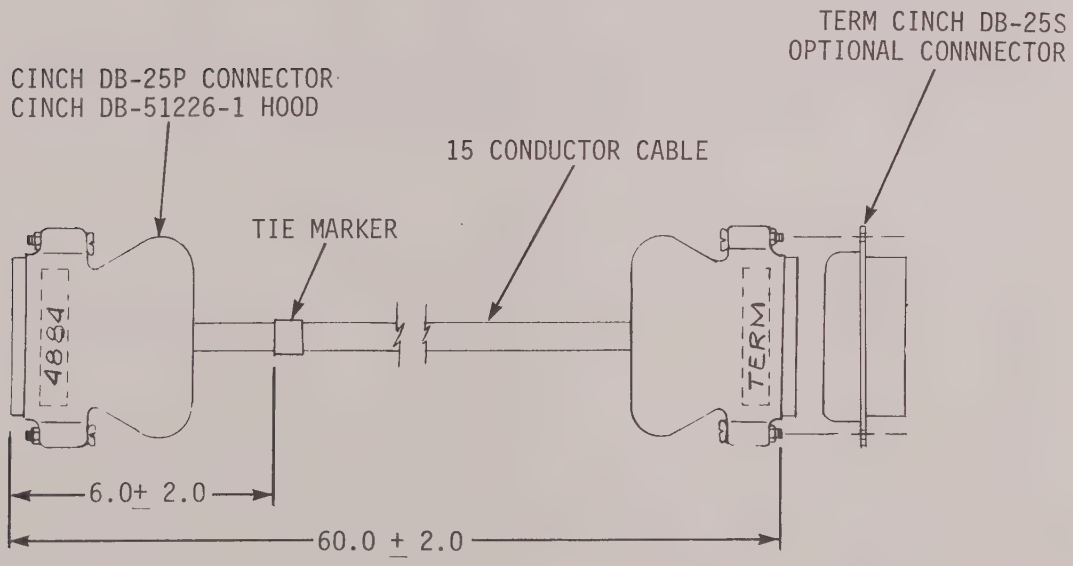


Figure 2-1 4885A RS-232 'T' CABLE

WIRE LIST TERMINAL CABLE

EIA CODE	SIGNAL	COLOR	4885-J2 PIN No.	TERMINAL J1 PIN No.
A A	CHS GND	BRN	1	1
B B'	RCVD DATA (1)	RED	13	2
B A'	TRANS DATA	ORG	17	3
A B	SIG GND	VIO	7	7
C A'	RDY-TO-SEND	YEL	19	4
C C	DSR	BLK	6	20
C F	RLSD		8	
C A	RTS		4	
C B	CTS		5	
C D	DTR	GRY	20	8
-	TERM DSR			6
-	TERM RTS			4
-	TERM CTS			5



NOTE: (1) USE WITH SOURCE SWITCH UP

Figure 2-2 4884/5A Terminal Cable Assembly

SIGNAL/ FUNCTION	CPU - P2 PIN No.	4885-J2 PIN No.	TTY - P2 PIN No.
CPU 20 mA IN +	8	21	
CPU 20 mA IN -	7	22	
CPU 20 mA SW OUT +	6	23	
CPU 20 mA SW OUT -	5	25	
TTY KYBD +		13	6
(UNUSED RS232 INPUT)		3	
TTY KYBD -		10	5
TTY PTR +		15	8
TTY PTR -		16 R1 R2	7
+12 V		24	
CA (REQ TO SEND)		4	
CB (CLR TO SEND)		5	
CD (TERM RDY)		20	
CC (DATA SET RDY)		6	
CF (SIG DET)		8	
TTY JUMPER		11	
TTY JUMPER		12	

R1, R2 = 27 K FOR 20 MA TELETYPES
R2 = 4.7 K FOR DEC 20 MA TERMINALS

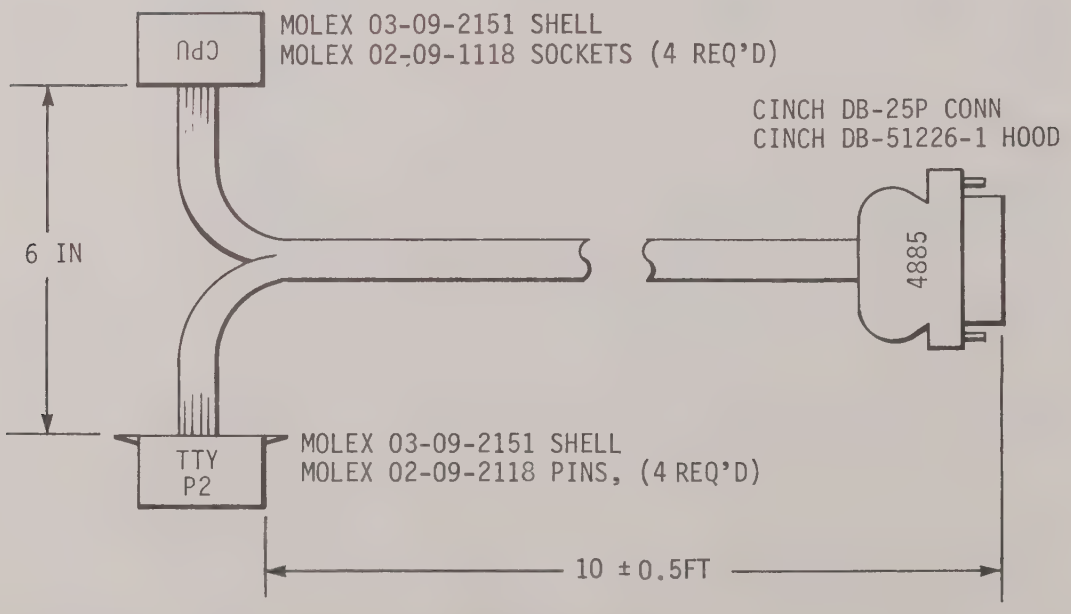


Figure 2-3 4885A Teletype "T" Cable

2.6.6 Connection to a Computer's 20mA Port

The 4885A can be connected to a computer's 20mA serial data loop by fabricating a four wire cable between the computer and the 4885A. Wire as shown in the 'CPU' '4885A' columns of figure 2-3, substituting the correct mating connector for the computer. Include all of the jumpers shown in the 4885A column in the 4885A connector. Adjust the 4885A's baud rate and character format to match the computer's settings.

2.6.7 Connection to a Teletype

The 4885A can be connected to a teletype or any other 20mA current loop terminal. If a teletype is used, it must first be modified for 20mA, full duplex operation. Refer to the Teletype Manual or field service technicians for correct jumper strapping directions to achieve the 20mA, full duplex operation.

Fabricate a cable to the teletype by following the '4885A' and 'TTY' columns in figure 2-3. Limit the cable length to 20 feet. Set the 4885A's rear panel SOURCE switch to the up position. Also adjust the 4885A's internal character format switch for 2 stop bits per character (paragraph 3.1.5). Always send the 4885A the @CTS command after a power turn-on or after each @@@ reset command to internally convert the 4885A for operation with a teletype terminal.

3

Operation

3.1 CONTROLS

3.1.1 Front Panel Controls

POWER — An alternate action push button that applies ac power to the interface. In is ON.

RESET — Momentary push button that resets the 4885A's internal logic.

STANDBY — An alternate action push button that prevents the 4885A Controller from responding to serial messages. Used to deactivate the 4885A when listing computer programs on the terminal.

3.1.2 Escape Character Switch

The ESCAPE character switch assembly is used to select the 4885A instruction escape character. The ESCAPE character switch assembly is a miniature 8 pole rocker switch mounted on the rear panel of the 4885A Controller. This switch is factory preset to the AT symbol (@) as shown below:

ADDRESS Switch Assembly

1	2	3	4	5	6	7	8	-	Switches (1 = LSB)
0	0	0	0	0	0	1	0	-	@ Code

To change the switch setting first look up the code for the desired escape character on an ASCII code chart (see Table 1-1). Secondly, write the desired code left to right, starting with the least significant bit. Set the eight switches to the new escape code, setting the unused 8th switch to 0 (Up is logic 1). Press the front panel RESET button to clear the unit after changing the escape code setting.

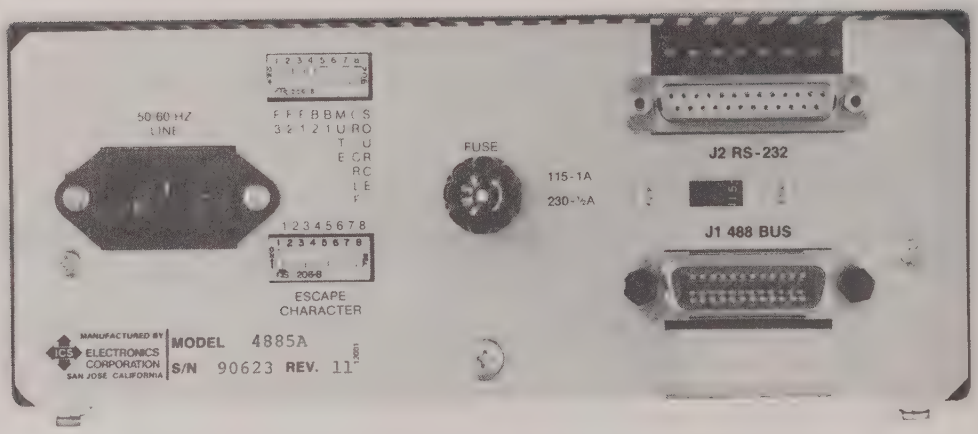


Figure 3-1 4885A Rear Panel

3.1.3 115/230 Switch

The Rear Panel 115/230 Switch adjusts the power supply for the ac line voltage. Check the switch setting prior to using the instrument. Use a small screw driver to slide the switch until 115 or 230 appears through the slot in the rear panel. For 115Vac operation, use the 1 ampere fuse supplied with the unit. For 230Vac operation, substitute an 0.5 ampere 3AG fuse. With the optional 100/200Vac transformer, the 115 position selects 100Vac and the 230 position selects 200Vac operation. Disconnect power cord before switching voltages.

3.1.4 Baud Rate Switch Assembly

The Rear Panel Baud Rate Switch Assembly contains the baud rate frequency, MUTE, CR/CRLF, and serial data SOURCE selection switches. Table 3-1 shows the switch settings for the standard baud rates.

TABLE 3-1 BAUD RATE SWITCH SETTINGS

Baud Rate	Switches F3	F2	F1	B2	B1
9600	1	1	1	1	0
4800	1	1	0	1	0
2400	1	0	1	1	0
1200	1	0	0	1	0
600	0	1	1	1	0
300	0	1	0	1	0
150	0	0	1	1	0
7200	1	1	1	1	1
3600	1	1	0	1	1
1800	1	0	1	1	1
900	1	0	0	1	1
450	0	1	1	1	1
225	0	1	0	1	1
110	0	0	0	0	1

NOTE

There are two types of minature switches used on the 4885A. Depress the rocker switches on the top for logic '1'; on the bottom for logic '0'. Slide switches are moved up for logic '1', down for logic '0'.

The MUTE switch controls the passing of the controller instructions onto the terminal. When the switch is on, the controller blocks any recognized instruction from being retransmitted to the terminal. When the switch is off, the controller sends all characters received on the serial I/O port onto the terminal. Normally the MUTE switch is left in the on position and turned off only for troubleshooting. Press RESET after setting the MUTE switch.

The CR/CRLF switch selects the characters used by the 4885A to end an output message. These output messages include Bus data responses, interrupt and error messages. The 4885A controller ends these messages with a CR (carriage return) when the switch is in the up position and with a CRLF when the switch is in the down position.

The SOURCE switch selects either the Modem or Terminal serial input pins as the controller's command source. Position the switch in the down or off position if the commands come from the Modem input on J2 pin 3. Position the switch in the up or on position if the commands come from the Terminal input on J2 pin 13. Positioning the switch does not affect the Controller's serial I/O initialization status shown in Table 1-3. Use the CTS command to internally configure the 4885A for use with the terminal.

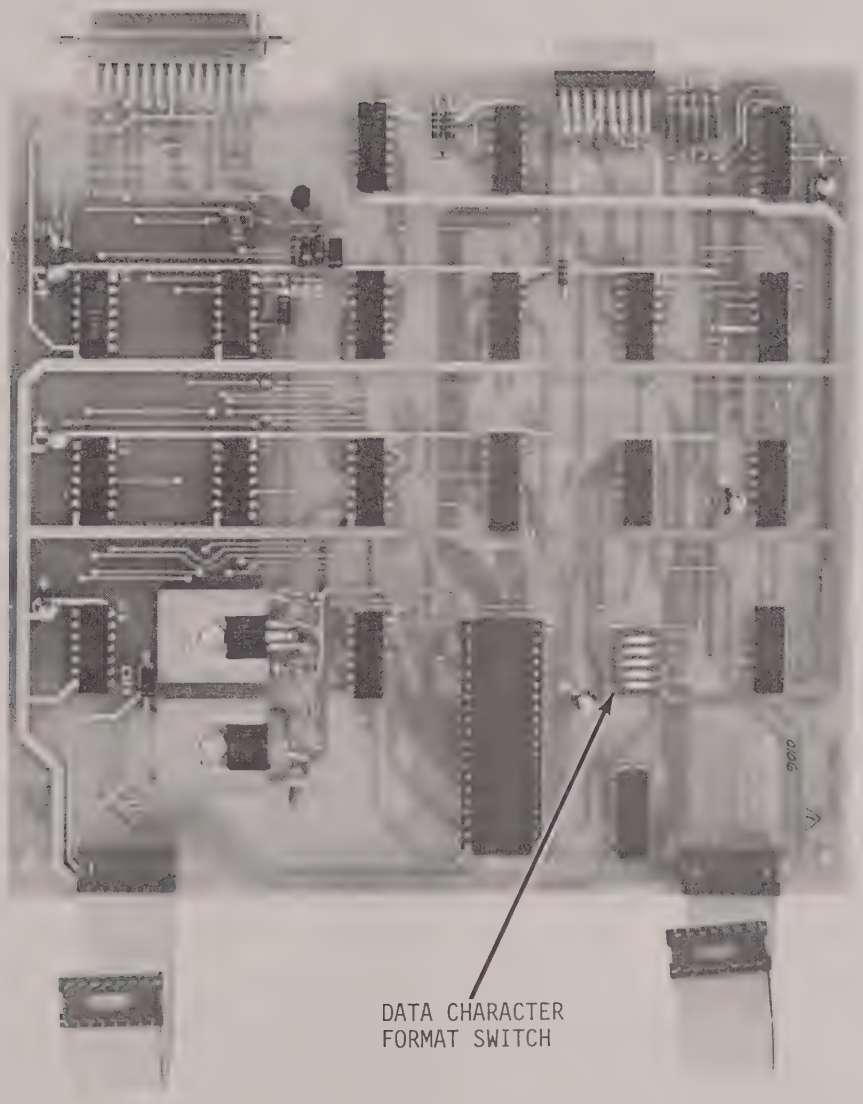
3.1.5 Data Character Format Switch

The internally mounted Data Character Format Switch is located on the upper board as shown in Figure 3-2. The Data Character Format Switch is factory preset for a serial character having 1 start bit, 8 data bits, no parity bit and 1 stop bits. To change the switch setting, remove the top cover and set the switch rockers by following the instructions in Table 3-2.

TABLE 3-2 DATA CHARACTER FORMAT SWITCH SETTINGS

Switch Rocker	Position	Function
EPE	0	Selects odd parity if PINH off
	1*	Selects even parity if PINH off
WS2,WS1	-	Selects number of data bits as follows:
		WS2 WS1 Bits 0 0 5 0 1 6 1 0 7 1 1 8*
2 STOP	0*	Selects 1 stop bit
	1	Selects 2 stop bits
PINH	0	Enables parity bit generation
	1*	Inhibits parity bit generation

* (Factory Setting)



NOTE: To select the logic '1' position, press the left hand side of the rocker down or slide the rocker to the left hand side of the switch. The left hand side is the side closest to the 40 pin IC.

Figure 3-2 Data Character Switch Location

3.2 OPERATING INSTRUCTIONS

3.2.1 Pre-Operation Setup

Before using the 4885A RS-232 to IEEE 488 Controller, connect the 4885A to the serial command source. Either use ICS supplied cables or refer to Section 2.6 for cable design instructions.

Use an IEEE 488 Bus cable to connect the Controller to the other IEEE Bus compatible instruments. Set the ESCAPE character, 115/230, baud rate and character format switches per Section 3.1. Plug the power cord into an ac power receptacle.

3.2.2 Operation

Depress the POWER switch to turn the 4885A on. The POWER indicator will come on. Place the STANDBY switch in the off position (switch out) and apply power to the devices connected to the Controller. The device(s) controls should be set for remote operation and control. The READY light will come on to indicate that the IEEE Bus signals are in their normal condition. If the READY light is not on, check the Bus for devices holding the ATN, EOI or IFC line low and/or the RS-232 interface for missing CC and CF signals. Do not proceed if the READY light is off since error conditions exist which will probably inhibit the Controller's operation.

Momentarily press the 4885A's RESET button. This resets the 4885A and causes the 4885A to output the IFC command to reset the devices connected to the Bus. The 4885A expects to be receiving data from a modem or computer after power turn on or after a reset command. This means that serial input text is passed onto the terminal and that data and error messages are outputted to the modem/ computer. To reverse this condition for operation from a terminal, send the 4885A the CTS command. The 4885A Controller is now ready to pass data to and from the IEEE 488 Bus.

The user can tell how the 4885A is responding by observing the 4885A's front panel indicators. The READY light stay on unless an error condition exists on the Bus or the RS-232 line. The TALKING light will come on when the 4885A is outputting messages to the bus. The LISTENING light will come on when the 4885A is expecting to receive data from the bus, i.e. while executing a RED command.

3.2.3 Programming Guidelines

The user can elect to send one or several instructions at one time to the 4885A. The 4885A will store the instructions and attempt to execute them in the order they were received. The user should be aware of the limitation of 256 characters on the input buffer and not overload it. In addition, if any of the instructions call for a response, the response data is outputted before the next instruction is executed. The serial command source must be programmed to accept the response data or it will be lost. It is suggested that the user structure his program so that the program waits for and receives one response before requesting another.

The 4885A accepts commands in both upper and lower case ASCII characters. Therefore, user is free to select the case or cases he desires or that best fits his command source.

It is a good practice to reset the 4885A Controller at the start of every test by sending it the triple escape command, @@@. Allow the controller 60msec to execute this command.

Read and Write commands are used to instruct the controller to pass data from and to the Bus. The operation of these commands can be altered by using a format instruction to store format specifications in the 4885A's memory. The format instruction must be sent to the controller before referencing the format number in a Read or Write command. Read and Write commands, that do not reference a format statement, default to use format #0. At power on time, format #0 is preset to 1 byte for RDB commands, to use the CR, LF or EOI terminators for RED commands, and to add CR and LF characters to data outputted to the Bus and to responses sent back over the RS-232 data path.

The 4885A Controller can be programmed to monitor the Bus SRQ line and send back a response each time the line is pulled low. The ONI instruction with the response message should be sent to the controller before sending the EIR command. This will avoid an error condition if the SRQ line happens to be low when the EIR command is received. The ONI instruction is required only once after power turn on or after a reset instruction.

The 4885A Controller can conduct a serial poll of the devices it is controlling. The user sends the RDS command with an address for each device to be polled. The 4885A responds to each RDS command by returning the status byte from each device to the modem/computer.

The 4885A Controller can be used to conduct a parallel poll of the devices attached to its Bus. To conduct the parallel poll, the user sends a POLC command to configure each device being polled, specifying the bit and polarity of each device's response. The POL command can then be sent as often as desired. The user sends either type of the POLU commands to unconfigure the devices on the Bus after completing the parallel poll.

3.2.4 External Reset and Data Routing

The 4885A uses two types of internal commands: one to remotely reset the controller and others which modify the 4885A's serial data output. The reset command consists of three sequential escape characters and forces the 4885A to clear all message buffers, reset all internal flags and output an IFC reset command to all devices on the Bus to clear any unusual conditions which may exists.

CAUTION - Do not repeat the escape character in the message field since the 4885A will reset if it counts three escape characters before the carriage return character.

The 4885A sends and receives serial messages over the four data paths shown in figure 3-3. The internal commands modify the data routing as shown in Table 3-3. At power turn on or after a reset instruction, the 4885A is in the CMS state and expects to receive instructions from the computer or modem. Depending upon the MUTE switch setting, the 4885A will pass on all or part of its serial input to the terminal. In the CMS state, the 4885A outputs all data and error messages to the computer. If the terminal is going to temporarily control the 4885A, set the SOURCE switch to the terminal position and use either the CTS or CTO instruction to route the data and error messages to the terminal. Depress the 4885's STANDBY switch to disable the 4885A while listing computer programs on the terminal.

CAUTION - The CB, CC and CF RS-232 handshake lines must still be properly managed when the terminal is the command source.

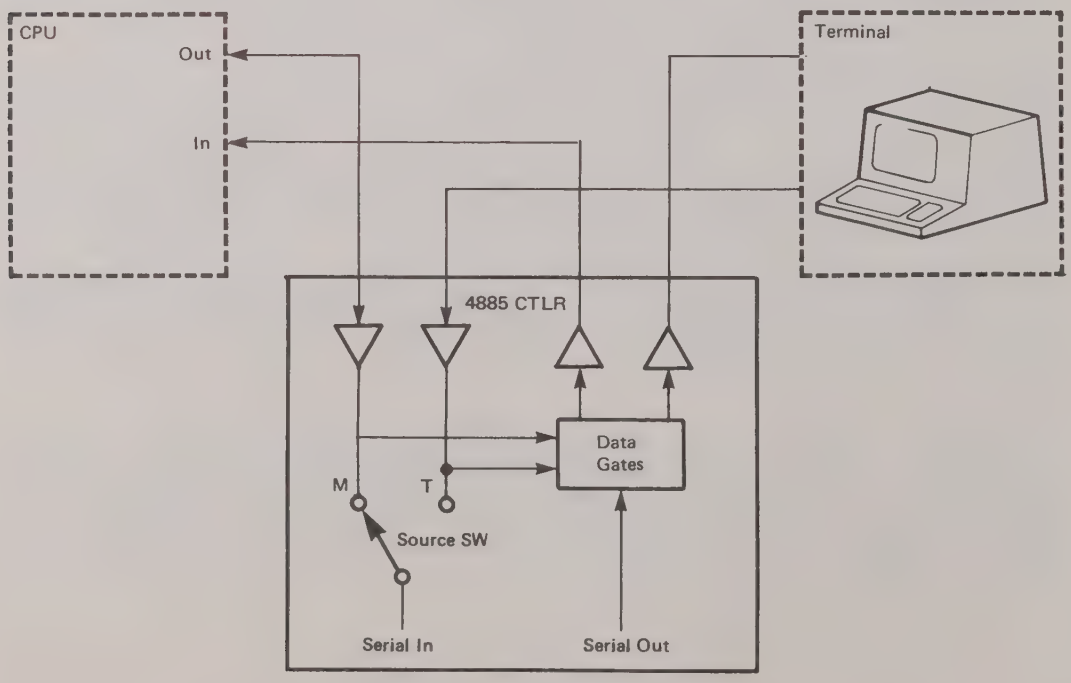


Figure 3-3 4885A Serial Data Paths

TABLE 3-3 SERIAL DATA ROUTING INSTRUCTIONS

Internal Command	Source Switch	Instruction/ thru routing	Terminal keyboard	4885A Outputs
CMS	CPU	4885A or thru to terminal	To CPU	To CPU
CTO	CPU	4885A or thru to terminal	To CPU	To CPU and to terminal
CTS	Terminal	4885A or thru to terminal	To 4885A	To terminal
CMO	Terminal	4885A or thru to terminal	To 4885A	To terminal and to CPU

3.3 MESSAGE FORMATS

This section contains a description of formats used by the 4885A Controller when receiving or outputting data and command messages. Table 3-4 shows each input command, its result on the Bus and the corresponding response sent back to the modem/computer.

3.3.1 Command Format

Each valid 4885A serial command starts with an escape character and ends with a termination character. The standard 4885A escape character is the @ (AT symbol), and the standard 4885A termination character is the CR (carriage return). The escape character is user changeable by a rear panel switch and the terminating character may be changed by altering the 4885A PROM as described in Section 3.4.

3.3.1.1 Syntax Rules

Each 4885A command must start with the escape character (@) to be recognized by the 4885A Controller. The escape character must be followed by the three or four characters that make up the command name. Spaces are not allowed between the escape and command name characters. Both upper and lower case characters may be used in the command name.

If a command is for a specific device on the Bus, the next group of characters will be the device address and an optional format number where required. If the command was not for a specific device, it should be terminated with a CR. Spaces are allowed after the command name but not between the escape character and the name.

TABLE 3-4 MESSAGE FORMATS

INPUT	BUS	OUTPUT
@WRT AA, D_1 D_2... D_N CR	UNL LAD D_1 D_2... D_N CR LF UNL	
@WTB AA, D CR	UNL LAD D CR LF	
@RED AA CR	UNL TAD **$D_1D_2D_N$ CRLF** UNT	**D_1...D_N** CR LF
@RDB AA CR	UNL TAD **D**	**D** CR LF
@TRG CR	GET^4 UNL	
@TRG AA CR	UNL LAD GET^4 UNL	
@CLI CR	(IFC PULSE)	
@CLR CR	DCL UNL	
@CLR AA CR	UNL LAD SDC^4 UNL	
@FMT F, NB, NT, Z CR	-	
@REM CR	(REN ON)	
@REM AA CR	(REN ON) + UNL LAD UNL	
@LCL CR	(REN OFF)	
@LCL AA CR	UNL LAD GTL^4 UNL	
@LLO CR	LLO UNL	
@DIR CR	-	
@EIR CR	-	
@ONI 'D...D' CR	-	
@RDS CR	S	S CR LF
@RDS AA CR	SPE^4 UNL TAD **D** SPD^4	**D** CR LF
@CMD 'C..C', 'D..D' CR	$C..^AC^A$ D..D	
@POL CR	$EO1^A$ **D**	**D** CR LF
@POLC AA, S S CR	UNL LAD PPC^4 PPE^4 UNL	
@POLU CR	PPU^4 UNL	
@POLU AA CR	UNL LAD PPC^4 PPD^4 UNL	
-	-	ERROR N CR LF

NOTES:
1. Underlined characters controlled by format statement. Selection of CR or CRLF is done by a rear panel switch.
2. BOLD characters are device response messages.
3. Super script A indicates ATN line on.
4. IEEE 488 BUS commands are shown in Table 1-1.

If data follows the address characters, the data is separated from the address by a comma. All characters between the comma and the terminating character (CR) are considered data. Spaces should not be placed in the data field unless they can be processed by the addressed device. If there is no data, the address characters are just followed by the terminating character (CR). Spaces are permitted between the address and the comma or CR.

3.3.1.2 FMT Command

The format (FMT) command is used to set internal 4885A parameters that are later used by different read and write commands that reference a particular format statement. For this reason, format statements must precede the command that references them. The FMT command has a statement identifier followed by three optional fields separated by commas. The optional fields may be in any order and spaces may precede the number character in each field. The last field is ended with a CR instead of a comma. The identifier field (F) contains a single digit 0 thru 5. Format #0 is the 4885's default format and is used by all read and write statements that do not contain a format number. Formats 1 thru 5 are set aside for the user's use.

The NB field controls the number of bytes read from the Bus by the RDB command. The field contains a single digit, 1 N 9, followed by the letter 'B'.

The NT field sets the message terminators looked for by the RED command when inputting data from the Bus. A detected message terminator is not stored in the 4885A's Data Reply Buffer while an undetected message terminator would be stored in the buffer. The field contains a single digit, 1 N 7 followed by the letter 'T'. The number 'N' selects the terminators in the following binary fashion.

N	Binary Value	Terminator
1	001	CR
2	010	Lf
3	011	CR or LF
4	100	EOI
5	101	CR or EOI
6	110	LF or EOT
7	111	CR or LF or EOI

The Z field inhibits the addition of the CR LF characters added to the RED and RDB data messages before they are serially outputted to the user's computer. (The position of the rear panel CR LF/CR switch selects either the CR LF or just CR characters). The Z field contains either the number 0 or the letter 'Z' where 'Z' deletes the characters and the number 0 adds them to the data message.

Some of the examples of the use of the FMT command are shown below:

i.e.	@FMT 3, 2B CR	Sets the RDB count to 2 bytes
	@FMT 2, 1B, Z, CR	Sets the RDB count to 1 byte and inhibits the addition of the CR LF characters to the data message
	@FMT 1, 2T, Z	Selects LF as the only terminator for the RED command and inhibits the addition of the CR LF characters to the serial data reply message. This format is used to read instruments which end their output with CR LF and cannot be terminated in the middle of their output sequence.
	@FMT 0, 1B, 7T, 0	4885A Power on default format

3.3.1.3 ONI Command

The ONI command stores all of the characters between the two single quote marks in the 4885A's memory. Maximum interrupt message capacity is 24 characters. Spaces may be used before the first quote mark to separate the data from the command name.

i.e.	@ONI 'GO to SUB1' CR	Stores 10 characters including 2 spaces in the interrupt response buffer

3.3.1.4 CMD Command

The CMD instruction has two fields containing characters that are directly outputted to the Bus. The first field is outputted as a Bus command or address characters, the second as Bus data. Each field contains all of the characters between the two single quote marks characters and the two fields are separated by a comma outside of the quote marks. CMD instructions with only the command field are terminated by the CR after the first field. The comma is not required in this case. CMD instructions with only the data field must have the field preceded by a comma. Spaces may be inserted in front of a field if desired.

i.e.	@CMD '$' CR	Commands device #4 to listen
	@CMD,'1' CR	Outputs hex 31 as a data byte
	@CMD '$', '1' CR	Combines above 2 examples in one instruction.

NOTE

Address 07 should be avoided if possible to prevent a possible conflict between it and a single quotation mark in the CMD instruction. Listen 07 is represented by the ASCII single quote mark and cannot be handled by the CMD instruction.

3.3.1.5 Address Rules

The address characters in the 4885A commands may be used to address any single addressed device, address an extended addressed device and reference a format statement. Addresses for a single addressed device contain two decimal digits and range from 00 to 30. The leading zero is required for addresses with values below 10. Addresses for extended addressed devices contain two sets of two decimal digits, each set ranging from 00 to 30. Separating characters are not permitted between the address characters and again leading zero's are required for address values less than 10.

i.e.	@RED 04 CR	Addresses device 04 as a talker
	@RED 0411 CR	Addresses device 0411 as a talker

Formats may be referenced by following the address digits with a period and a single digit ranging from 0 to 5. Format instructions only modify the operation of the Read/Write instructions as shown in Table 3-3 and are only required for those instructions. The 4885A automatically uses format number 0 for those instructions that do not reference a specific format number.

i.e.	@WTB 04, 1 CR	Uses format 0
	@WTB 04.3, 1 CR	Uses format 3

3.3.2 Bus Messages

4885A Bus messages are shown in the center column of Table 3-4. The 4885A normally starts all bus messages with the unlisten command and ends each message by taking the device out of the listen or talk state. The exceptions to this rule are the RDB and WTB commands which pass only binary data on the Bus and the RDS command. The RDS command is used to serially poll a number of devices and is normally followed by more RDS's until all devices have been polled. The untalk command (CMD'_') should be sent after the last RDS.

Data messages put on the Bus by the WRT and WTB instructions are normally followed by the CR and LF characters. These characters are automatically added by the 4885A unless inhibited by the Z field in the format specification.

3.3.3 4885A Responses

4885A Responses to various instructions are shown in the third column of Table 3-3. The 4885A automatically adds a carriage return, or a carriage return and line-feed characters to each response unless inhibited by the Z field in a referenced format statement (see Section 3.3.1.1 for format reference instructions and Table 1-2 for a definition of the format instruction). The selection of the CR or CRLF characters is controlled by the position of the rear panel CR/CRLF switch (see Section 3.1.4).

3.3.4 4885A Error Messages

The 4885A can recognize various error conditions and will send coded error messages describing the problem to the computer/modem. These messages are especially valuable while debugging a new program. The user should design his program so it will recognize an error message and notify the user. The 4885A's error messages and their meanings are listed in Table 3-5.

The 4885A Error messages have the following format:

ERROR b N CR LF

Where: b is a space and N is the error message number.

TABLE 3-5 4885A ERROR MESSAGES

Error	Description
1	**Command Mismatch** - Instruction input did not match the commands listed in Table 1-2.
2	**Syntax Error** - Instruction format is incorrect or was erroneously received. Try again.
3	**Address Value Error** - Address number out of range. Should be between 00 and 30 decimal.
4	**None/Wrong Format** - Either an undefined format statement was referenced or the format statement is incorrect.
5	**No devices on the Bus** - Controller did not receive a response to the ATN line within 500 usec.
6	**Input Buffer Overflow** - User has inputted instructions faster than the 4885A can execute them.
7	**Format Number Error** - Format number out of range. Should be between 0 and 5.

3.4 INTERNAL PROGRAM CHANGES

The user can modify certain aspects of the 4885A's performance by altering the contents of various program tables stored in PROM's. The user alterable features include command termination character and some initializaton parameters. The PROM's are plug-in IC's capable of being erased by ultra violet light. General directions for modifying the PROM's are given in Section 3.4.1 and specific table locations and definitions are covered in Section 3.4.2.

3.4.1 PROM Alteration Instructions

Alterting the 4885A's PROM's requires the use of a PROM Programmer that can erase and program 2708 PROMS and a minimum of 2 spare 2708 PROMSs. Do not disassemble the Controller until you have located a PROM programmer and have the spare PROMS. If a PROM Programmer is not available locally, you can request a PROM programmed to your exact configuration directly from ICS Electronics. Perform the following steps to change or alter the 4885A PROMS.

a) Disconnect all cables and power cord from the 4885A Controller.

b) Remove the four screws holding the cover to bottom plate. Tilt the unit to slide the electronics assembly out the front.

c) Two 2708 PROMs are located on the right rear side of the main (lower) board. Locate the Prom to be changed and use a flat bladed tool to pry it evenly up out of its socket. Skip d) if the PROM is to be replaced by a factory furnished PROM. See Figure 3-6.

d) List the section of the PROM to be changed and verify that it matches the tables given in Section 3.4.2. Make the changes by duplicating the good portions of the PROM onto a new PROM. Program in all changes and check by listing them back. Verify that all other portions of the original PROM have been duplicated on the new PROM. Do not erase the original PROM.

e) Place the new PROM back in the socket. Line the PROM's pins up carefully with the socket and use a rocking motion to push the PROM into the socket. Check to see that all pins went into the socket and that none were bent underneath.

f) Reverse steps b) and a) to close the unit.

g) Erase the original PROM only after thoroughly testing the Controller.

3.4.2 PROM Program Tables

This section covers the 4885A PROM Program Tables that can be modified by the user to change the 4885A's operation. All data is in hex code format, and each character has two hex digits or eight bits. Bit 1 or the LSB is on the right. Logic '1' produces a high signal unless otherwise noted.

3.4.2.1 Termination Character

The 4885A can be modified to use a special command termination character by altering the PROM location shown in Table 3-6. To modify the 4885A, substitute the ASCII code for the desired character in place of the standard character code in Table 3-4.

TABLE 3-6 TERMINATION CHARACTER CODES

Prom	Address	Standard Code	Character	Description
08	0B5D	0D	CR	Instruction Terminator

3.4.2.2 Initialization Table

The initialization Table, Table 3-7, sets up the initial condition of all output signals and memory flags at power on or after a reset condition. User alterable areas are labeled UA and include: RS-232 I/O configuration, Format #0, GP-IB Bus output and front panel lights. When making RS-232 or GPIB interface changes, the user must also change the appropriate memory status values to avoid confusing the controller.

3.5 PWB CHANGES

There are no user changeable jumpers in the 4885A Controller. The unit is shipped with two jumpers on the main board which connect the '+' pad to the 'E' pad and the 'I' pad to the 'DR' pad. These jumpers are to be left in place at all times.

3.6 USER PROGRAM AIDS

This section contains sample 4885A programs to assist the user in developing his own software for the 4885A Controller. Exact samples for each user's computer or program source are impossible to generate due to the number of different types of computers and languages variations. However, these samples do show the user the correct 4885A command sequences for typical instrument control functions.

TABLE 3-7 INITIALIZATION TABLE

PROM	Address	Code		Description
08	0BC8	01		
08	C9	03		
08	CA	04		GPIBSIG Memory
08	CB	20	UA	GPIB Signals, REN on
08	CC	04		
08	CD	0B		
08	CE	04		RS-232 I/O Status Memory
08	CF	01	UA	CA F/F, CA off
08	D0	00	UA	CD F/F, CD on
08	D1	02	UA	Response, to modem
08	D2	09		Thru data, to modem, out to term
08	D3	03		
08	D4	C2		
08	D5	04		Format #0 Address
08	D6	00		Format #0
08	D7	01	UA	Byte count, one
08	D8	00	UA	Z, CR&LF enabled
08	D9	03		
08	DA	03		
08	DB	06		RS 232 I/O interface
08	DC	01	UA	CA F/F, CA off
08	DD	00	UA	CD F/F, CD on
08	DE	09	UA	Latch, modem thru, output to term
08	DF	06		
08	E0	02		
08	E1	07		GPIB BUS I/O
08	E2	00	UA	GPIB Data, none
08	E3	20	UA	GPIB Signals, REN on
08	E4	80		OUT ENA F/F, on
08	E5	00		-
08	E6	00		-
08	E7	00	UA	LIGHTS, all off

3.6.1 HP 9825A Samples

The sample programs were generated on an HP 9825A Calculator which acted as the remote computer. The HP 9825A Calculator drove an ICS Model 4884 IEEE to RS-232 Coupler which provided the serial data link to the 4885A Controller as shown in Figure 3-4. In some cases, the 4885A was controlling an ICS Model 4883 Instrument Coupler with a wrap around cable for closed loop testing, or, with a switch box for dummy data inputs. In some cases, the 4885A was inputting data from different instruments. In most cases, the sample programs are longer than what is necessary to perform their function due to the overhead involved in operating the 4884 Coupler. Program instruction with the 704 address are 4884 Coupler instructions and all 4885A commands are in double quotation marks.

As a general rule, it is beneficial to reset both the 4885A Controller and the device attached to the Bus at the start of a program. This may be accomplished by sending the 4885A the triple escape command, @@@.

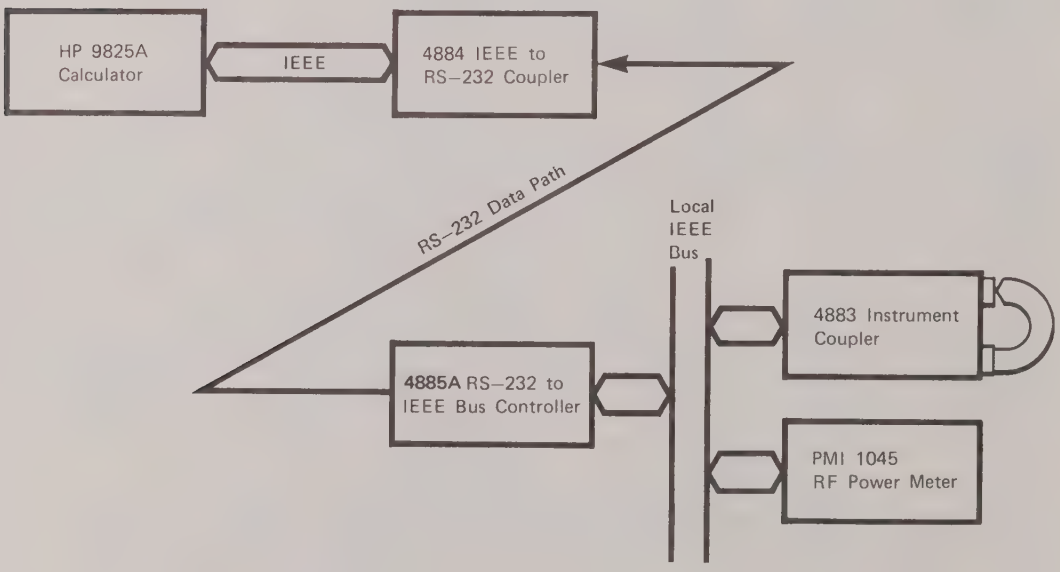


Figure 3-4 HP 9825A - 4885A Test Hookup

3.6.1.1 **Address Test Program** (See Figure 3-5)

Program tests a device's response to Talk, Listen and Untalk/Unlisten commands. The sample program demonstrates the 4885A's Reset and CMD instructions.

The program initializes the string, resets the 4885A and then steps thru the Talk, Listen and Untalk/Unlisten modes in 0.5 second intervals. Any error message returned by the 4885A would cause the program to jump to label "SRQ" and display the error message.

```
0: "Device 04
 Address Test":
1: dim R$[5],
 U$[10],T$[10],
 L$[10]
2: "@@␣"→R$
3: "@cmd'?_'"→U$
4: "@cmd'$'"→L$
5: "@cmd'D'"→T$
6: clr 7
7: cmd 7,"?"
8: wait 100
9: oni 7,"SRQ"
10: eir 7
11: "REP":wrt
 704,U$
12: cmd 7,"?"
13: wait 500
14: wrt 704,T$
15: cmd 7,"?"
16: wait 500
17: wrt 704,L$
18: cmd 7,"?"
19: wait 500
20: gto "REP"
21: "SRQ":red
 704,A,B
22: cmd 7,"_"
23: dsp "Error
 ",A
24: beep
25: wait 500
26: eir 7;iret
27: ret
*2571
```

Figure 3-5 Address Test Program Listing

3.6.1.2 4883 Loop Test (See Figure 3-6)

The 4885A Controller outputs a 10 digit number to a 4883 Coupler with a loop around test cable. The program reads the result back and compares it to the original for any errors. The number is incremented, digit-by-digit, until all 9's have been sent.

The sample program demonstrates the 4885A RED and WRT instructions. The program starts by initializing the strings and variables. Line 10 forms the WRT instruction and line 11 outputs it. Line 12 outputs the 4885A RED instruction to read the looped back data. The actual data is read by the interrupt routine, "SRQ". When the data is read, the number is checked in line 16 and incremented. Error conditions are marked by a beep. The "END" sub-routine displays "N Tests Completed" and jumps to "RESTART" to repeat the test.

3.6.1.3 Power Meter SRQ Interrupt Test (See Figure 3-7)

The interrupt driven program takes a continuous series of readings from a Pacific Measurement RF Power Meter, Model 1045, and computes a running average. The program takes advantage of the 4885A's ability to sense an instrument's service request (SRQ) and initiate the data input routine.

The program starts by dimensioning the input string (R$), sets variables and resets the 4885A (line 4). "REP" is the data processing routine. The command in line 10 instructs the Power Meter (LAD=0) to take a reading. The program waits at "LOOP" until data is inputted by the interrupt routine "SRQ".

The interrupt routine, "SRQ", checks for the 4885A's interrupt message in lines 22 and 23. The message was stored in the 4885A in line 8. Line 29 reads the data from the Power Meter (TAD=02) and line 31 inputs it into the calculator from the 4884 coupler.

3.6.1.4 Format Demonstration (See Figure 3-7)

The format demonstration program shows the affect of the format statement on input data. The standard output format of the PMR Model 1045 Power Meter is:

+NNNN, NC CR LF

where:

N is a number

C is a alpha character representing different units

CR is a carriage return

LF is line feed

```
0: "9-String
 4883 Loop test"
 :
1: 1→N;fxd 0
2: dim A$[12],
 B$[12],C$[30],
 P$[10]
3: "@WRT04,"→P$
4: "RESTART":100
 0000000→A
5: 1→K;1→C;0→B
6: wrt 704,"@@@"
7: cmd 7,"?"
8: wait 200
9: "REP":str(A)→
 A$
10: P$&A$→C$
11: wrt 704,C$
12: wrt 704,"@RE
 D04"
13: cmd 7,"?"
14: "LOOP":oni
 7,"SRQ";eir 7
15: if B=0;sto
 "LOOP"
16: if A#B;sto
 "ERR"
17: 0→B
18: A+K→A
19: C+1→C
20: if C#10;sto
 "R"
21: K*10→K;1→C
22: "R":if A>100
 00000000;sto
 "END"
23: sto "REP"
24: "ERR":beep
25: wait 1000
26: sto "REP"
27: "SRQ":red
 704,B$
28: cmd 7,"_"
29: val(B$)→B
30: dsp N,A,B
31: eir 7;iret
32: "END":wait
 200
33: dsp N,"Tests
  Completed"
34: N+1→N
35: wait 500
36: sto "RESTART
 "
37: end
*7133
```

Figure 3-5
4883 Loop Test
Program
Listing

```
0: "10-Pwr Meter
  SRQ Test":
1: dim R$[15]
2: 0→A;0→N
3: clr 7
4: wrt 704,"@@@"
 ;cmd 7,"?"
5: wait 200
6: "REP":
7: oni 7,"SRQ";
 eir 7
8: wrt 704,"@oni
 '13'"
9: wrt 704,"@eir
 "
10: wrt 704,"@wr
 t01,1H?"
11: cmd 7,"?"
12: "LOOP":
13: if R=0;sto
 "LOOP"
14: S+R→S;N+1→N
15: S/N→A
16: dsp "Average
  of",N,"rdgs=",
 A
17: 0→R
18: wait 1000
19: sto "REP"
20: "SRQ":
21: 0→R
22: red 704,B;
 cmd 7,"_"
23: if B#13;sto
 "RET"
24: wrt 704,"@rd
 s02";cmd 7,"?"
25: wait 200
26: fmt 1,b
27: red 704.1,D;
 cmd 7,"_"
28: if D<64;sto
 "DISP"
29: wrt 704,"@re
 d02";cmd 7,"?"
30: wait 200
31: red 704,R$;
 cmd 7,"_"
32: val(R$)→R
33: "RET":
34: iret
35: "DISP":
36: dsp D
37: stp
38: end
*3595
```

Figure 3-6
Power Meter
SRQ Interrupt
Test

The power meter's complete output message is read by the first 9 characters format (line 9). The following 5 and 3 character formats read only the first few characters as shown in the accompanying printout. Note that the plus sign is suppressed by the calculator's printer.

```
0: "11-Pwr Meter
  Format Demonst
 ration":
1: dim R$[15]
2: fmt 2,f3.0,
 4x,f8.2
3: clr 7
4: wrt 704,"@@@"
 ;cmd 7,"?"
5: wait 200
6: prt " "
7: prt "FORMAT
 READING"
8: 9→F
9: wrt 704,"@FMT
  1,9B"
10: gsb "SUB"
11: 5→F
12: wrt 704,"@FM
 T 1,5B"
13: gsb "SUB"
14: 3→F
15: wrt 704,"@FM
 T 1,3B"
16: gsb "SUB"
17: prt "End"
18: gto 5
19: end
20: "SUB":
21: cmd 7,"?"
22: wait 100
23: wrt 704,"@WR
 T01,1H?"
24: cmd 7,"?"
25: wait 500
26: wrt 704,"@RD
 B02.1";cmd 7,
 "?"
27: wait 200
28: red 704,R$;
 cmd 7,"_"
29: dsp R$
30: wrt 16.2,F,
 R$
31: wait 500
32: ret
33: end
34: prt
```

```
FORMAT  READING
  9    -6242,-2%
  5     1078
  3     10
End

FORMAT  READING
  9     1075,-0
  5     1075
  3     10
End

FORMAT  READING
  9     1075,-0
  5     1075
  3     10
End
```

Calculator Format Printout

Figure 3-8 Format Demonstration Program Listing

3.6.2 Xerox 560 FORTRAN Example

Figure 3-9 shows the 4885A connected between a timeshared computer and a terminal. The computer was a Xerox 560 and the communication to it was via a modem. The terminal was a TI Silent 700 series Terminal. The user fabricated a junction box, similar to the 'T' cable in figure 2-1, to connect the 4885A to the system.

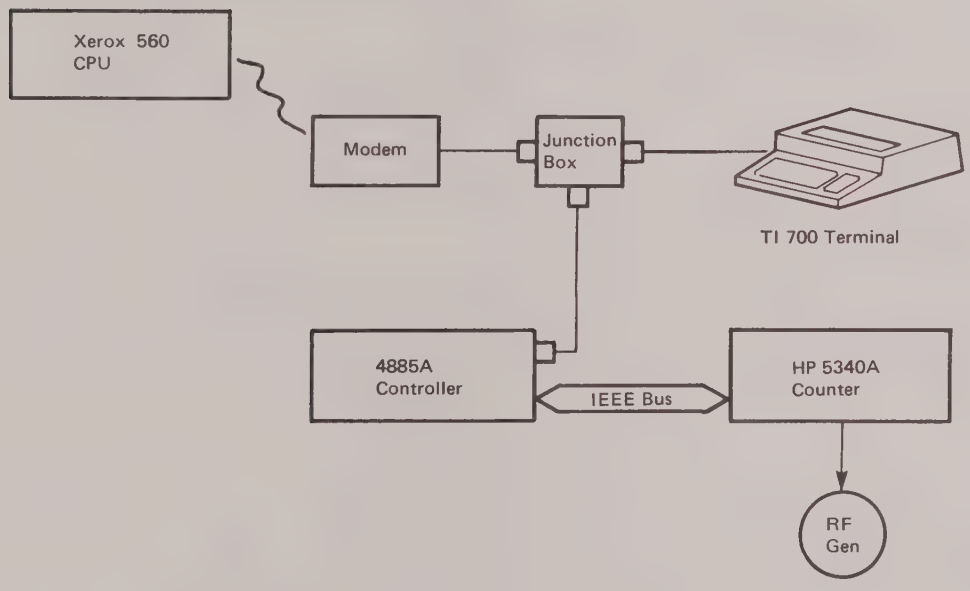


Figure 3-9 Xerox 560 - 4885A Hookup

The purpose of this application was to make repetitive measurements of different RF sources and have the computer do real time analysis of the data. The 560 computer was programmed by the engineer from his local TI-700 Terminal. The 4885A's front panel STANDBY switch was depressed to deactivate the 4885A while listing the program on the terminal. The 4885A's escape character was set to a "%" sign to avoid a conflict with a "@" symbol used in the 560's FORTRAN language. The 4885A's CRLF/CR switch was placed in the CR position to delete the unwanted CR's in the reply messages to the computer.

The user's program made repetitive measurements of the different RF frequencies on cue from the test engineer. The extracted program statements in figure 3-10 are used to communicate with the HP5340A counter thru the ICS 4885A Controller. Statement 5 initializes the HP3540A counter as suggested in its operating manual. Statement 6 triggers the counter to take a reading and statement 7 instructs the 4885A to read the data from the counter and to send it in serial form to the computer. The following instruction: "READ 75, IA" instructs the computer to input the data from the counter into variable IA for further processing.

```
      DIMENSION IA (20).
                .
                .
                .
                .
      CALL WAIT (2)
      PRINT 5
5     FORMAT ('-', '%WRT 02, 3KMO')
      PRINT 6
6     FORMAT ('-', '%WRT 02,H')
      PRINT 7
7     FORMAT ('-', '%RED 02')
      READ 75, IA
      IF (I.EQ.0)  CALL PROMPT
```

Figure 3-10 Xerox 560 FORTRAN statements for operating the 4885A Controller

4

Theory of Operation

4.1 BLOCK DIAGRAM DESCRIPTION

4.1.1 Simplified Block Diagram

The 4885A RS-232 to IEEE 488 Bus Controller block diagram is shown in Figure 4.1. The 4885A Controller is a microprocessor based device that interprets instructions and transfers data in a bidirectional fashion between an RS-232 serial command source and the IEEE 488 Instrument Bus. Each 4885A Controller contains the 488 Bus Drivers-Receivers, Program Memory, RAM Memory, the microprocessor and the Serial Interface. The Serial Interface provides RS-232 signals to the modem/computer and both RS-232 and 20mA current loop signals to a terminal.

The input instruction flow is from right to left, in Figure 4-1, with the characters first being received by the Serial I/O card and then interpreted by the microprocessor. The resultant commands and/or data are then outputted to the Bus via the IEEE 488 Interface. Data from the Bus flows in the opposite direction. The reply data is first received from the Bus devices via the IEEE 488 Interface. The reply data is then assembled into the response message and outputted to the modem/computer or terminal via the Serial I/O card. The PROM provides storage for the 4885A programs which include the data received routine, interpret, Bus SH and AH, message assembling and RS-232 output routines plus lessor ancillary programs and data tables. The RAM provides 512 bytes of storage for data, I/O status and program control flags.

The RS-232 control signals are managed so as to handshake with those RS-232 devices capable of operating with the signals. Signals CC and CF are sensed to generate the RS-232 line ready signal. Request-to-send (CA) is raised and CB, CC and CF are checked prior to sending data out on BA. Data-Terminal-Ready (CD) is initially set high and dropped whenever the received data buffer becomes within 4 characters of being full. CD is raised again as soon as the buffer is emptied onto the IEEE 488 Bus and has room for 5 or more characters.

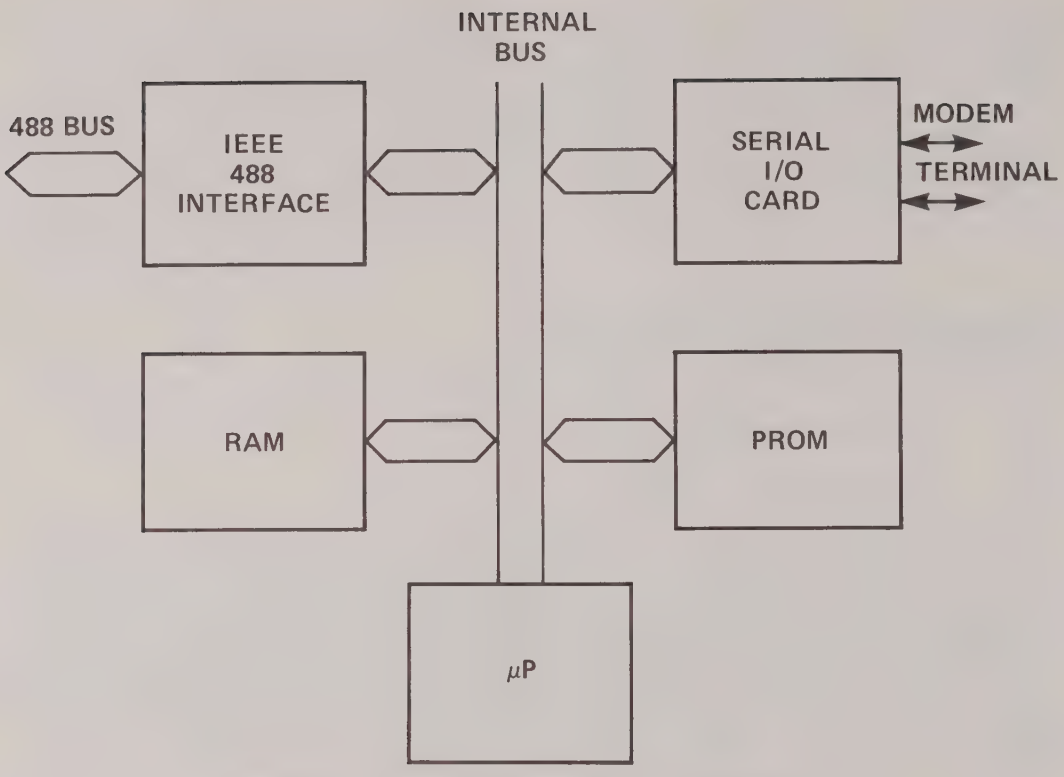


Figure 4-1 4885A Simplified Block Diagram

4.1.2 Detailed Block Diagram

The 4885A RS-232 to IEEE 488 Bus Controller Detailed Block Diagram is shown in Figure 4-2. The block on the right hand side contains a simplified schematic of the serial I/O card. The user positions the SOURCE switch which selects either the received data from the modem/computer (BB) or terminal output (BA') as the serial command input. As serial bits are received the UART assembles them into a parallel 8-bit character. The input baud rate and character bit pattern are user preset by means of the BAUD RATE and FORMAT switches.

When the UART has received a complete serial character, the UART generates an interrupt to the microprocessor via the DR line. The microprocessor then inputs the character and checks it against the escape character. If the received character is the escape character, the command flag is set and the character is stored in the data received buffer. The MUTE switch is then checked to see if the character should be retransmitted to the terminal. If the character is not the

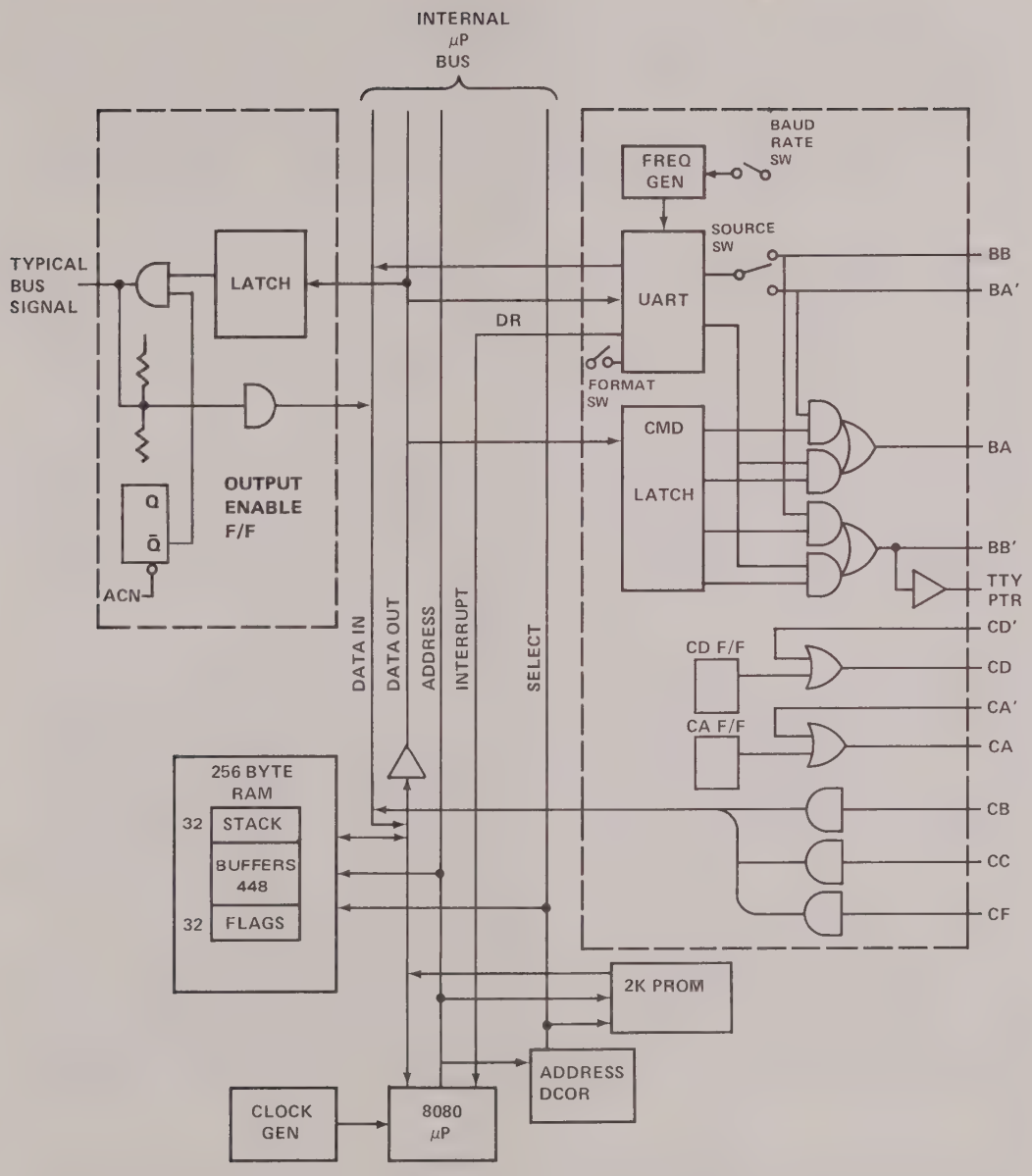


Figure 4-2 4885A Detailed Block Diagram

escape character, the command flag is checked to see if one is being received. If a command is being received, the character is stored in the data received buffer and processed just like the escape character. Each subsequent character receives the same processing until the command termination character is detected. At that point, the command flag is reset and the interpret routine is called to execute the received instruction. Characters received when the command flag is off are automatically outputted to the terminal.

The microprocessor initializes the output CMD LATCH to enable the terminal output data (BA') to pass to the modem input (BA) and to output data from the UART to the terminal input (BB'). This assumes that the user will select the modem/computer input as the command source. To change the initialization, the user alters the PROM per 3.4.2.2 or sends the 4885A the CTS instruction which reverses the output and thru assignments.

The RS-232 control signals are managed so as to handshake with those RS-232 devices capable of operating with the signals. Signals CC and CF are sensed to generate the RS-232 line ready signal. Request-to-send (CA) is raised and CB, CC and CF are checked prior to sending data out on BA. Data-Terminal-Ready (CD) is initially set high and dropped whenever the received data buffer becomes within 4 characters of being full. CD is raised again as soon as the buffer is emptied onto the IEEE 488 Bus and has room for 5 or more characters.

The 8080 Microprocessor transfers all data as 8-bit bytes between the I/O blocks and the RAM. The transfer sequence is under the control of programs stored in the PROM. During the execution of each program instruction, the microprocessor first addresses the PROM, reads the current instruction (1, 2 or 3 bytes) and then executes the instruction, often by moving data into or out of the microprocessor. The address decoder converts the four most significant address lines into select lines for the PROM, RAM Serial I/O and 488 Interface functions. The clock generator produces a two phase microprocessor clock at a 1,8432 MHZ rate which is also used by the Serial I/O card to generate the different baud rates.

The RAM provides temporary read/write storage for data and program information. It is subdivided into three major areas. Program control flags and status information are stored in the bottom 32 bytes. Data received instructions are stored in the bulk of the memory while the 8080 stack uses the top 32 bytes. The RAM is a volatile storage element and all memory is lost when power is turned off.

The block on the upper left hand side of Figure 4-2 is the IEEE 488 Interface. The figure shows a simplified schematic of one channel of the interface. The complete IEEE 488 Interface contains 16 bi-directional channels which are all capable of driving as well as receiving data from the local IEEE 488 Bus. The 16 Bus lines are divided: 8 for data, 5 for control and 3 for data transfer handshakes. The data characters sent by the 4885A represent either address or commands (ATN on) or data characters (ATN off). Characters received by the 4885A may be only data characters since the 4885A is the only controller allowed on the Bus.

4.2 DETAILED LOGIC DESCRIPTION

4.2.1 **Main Board**(See Figure 7-1 sheets, 1, 2 and 3)

The two phase microprocessor clocks are generated by U11, which performs a divide-by-eight operation on the clock pulses from the oscilator U6 and crystal Y1. Memory addressing is accomplished by an 12 bit memory address bus. The lower eight bits directly address the memory byte; the upper four bits operate a decoder, U4, which selects the device being addressed. Data is transferred to the microprocessor on a bidirectional bus. Data bus drivers U9 and U10 are used to drive the output latches in the Bus and Output Logic sections. Capacitor, C15 and resistor R9 are used to generate the power-on clear pulse. The IFC command coupled on capacitor C19 also generates a reset pulse.

Flip-flop, U40, senses the microprocessor's interrupt acknowedged status output on data line D0 during sync time. The flip-flop is then set for one clock time during which the flip-flop forces all inputs off of the bidirectional data bus, thereby generating the 8080's RST7 command. The 8080 microprocessor program counter jumps to location 0038 hex as a result of this command. Depending upon the state of the jumper in pad 1, interrups come when the IEEE 488 ATN line goes low (I-A) or whenever the upper board has data ready (J-DR).

IEEE Bus Signals are terminated in resistor networks U24 and U32 before being gated onto the microprocessor data bus by gates U22,23,30 and 31. Bus output signals are stored in latches U25-28 before passing thru the output drivers U33-36. Decoder U17 generates the latch load pulses and gate strobe pulses when the main decoder drops the AS7 line. Latch U18 is used to enable or disable the output drivers depending upon the state of the Bus E01 and ATN lines. Latch U18 can also be set under program control by raising data line D07 and generating strobe pulse 4 from decoder U17.

The 4885 power supply transformer can be switched to operate from 115 or 230Vac power by switch S4. Capacitor C1 filters the unregulated +22Vdc output. Regulator Q3 convers the unregulated voltage to +12 volts for the clock drivers. Regulator Q1 provides the +5 Vdc for all of the Coupler's TTL logic chips. Capacitor C4 filters the unregulated -15Vdc output. Regulator Q2 Converts the unregulated voltage to the -5Vdc microprocessor bias voltage.

4.2.2 **Serial I/O Card** (See Figure 7-2)

This Serial I/O card contains the following major functions: power regulations, serial-to-parallel conversion, RS-232 interfaces, 20mA interfaces, and baud rate clock generation. Q3 and Q2 are three terminal regulators which provide -12V and +12V respectively to the UART, U18, and the RS-232 drivers. Power to the drivers is taken through diodes CR1 and CR2 to protect the drivers. The UART, U18, converts the serial input data into parallel form and parallel data into the output serial bit stream. When the UART has received a serial character it raises the DR signal which generates the negative interrupt, DR, through inverter, U11. Address 0601 drops the DRR input, resetting the DR flag, and drops the RRD input which gates the received data (RR1-RR8) onto the microprocessor data bus. Address 0600 enables gates U14 and U17 which gates the UART's status signals onto the data bus. Output data is loaded into the UART by address 0601 which causes the Thrl line to go low. All decoded address lines are enabled only during a write or data input time by the W/DBIN signal.

Baud rates are generated by selecting the proper rate from 16 counter chips U9, U15 and U19. Switch B1 changes U9 to a 12 counter when open. Switch B2 changes U9 and U15 to be a 132 when open. Switches F3, F2 and F1 enter a 3-bit code into selector, U3, to transmit the correct baud rate to the UART.

Quad receivers U1 and U4 convert the RS-232 serial data signals to TTL levels. Driver U5 converts levels and TTL serial data to +12V output levels. Transistor Q1 converts the serial voltage waveform into a 20mA current source to drive a 20mA teletype. The command latch, U13, is loaded by address 0605 and controls the gates which route the serial data to the RS-232 drives.

Optical isolator U21 converts a 20mA current into a negative true TTL level which is ORed into the received data line by OR gate UIO. Optical isolator U22 converts the negative true spacing level from U10 pin 8, into a saturated transistor output. The transistor appears as a floating open or closed switch to the computer TTY keyboard sensing circuit.

CD latch, U7, output is ORed with the terminals CD signal by driver U5 to generate the output CD signal. CA latch U7 similarly generates CA which is ORed by driver U5 with the terminal's CA signal to generate the output CA signal. Gates U14 and U2 transfer the RS-232 signals, MUTE and ACK/NAK switch status to the data bus upon receipt of address 0606.

5

Maintenance

5.1 INTRODUCTION

This section describes the maintenance and troubleshooting procedures for the Model 4885A Bus Controller. The 4885A Bus Controller does not require periodic calibration and has no internal adjustments. This section also includes a brief description of the 4885A's logic convention and symbols.

5.2 REFERENCE DESIGNATIONS

The 4885A Bus Controller is assembled in a one-half-rack-wide chassis with components mounted on circuit boards and the rear panels (see figure 6-1). The circuit boards are mounted horizontally; the large bottom board is designated A1 and the other board is designated A2. Components on schematics and parts lists are designated by the partial reference designation; i.e.e, Q1 rather than the complete form, A1Q1. Board component locations are shown in Figures 6-2 and 6-3.

5.3 TROUBLESHOOTING PROCEDURES

This section describes procedures for locating and correcting basic coupler problems. It is assumed that the user has a good grasp of his overall system, some basic electronic knowledge and has read the Controller's theory of operation in Section 4.1. Section 5.4 is a quick review of the more common digital logic symbols found on the Controller's schematics.

Basic troubleshooting techniques vary depending upon whether this is an initial hookup or a failure in a working system. The following guide is to aid the user in solving initial turn-on problems.

1. Familarize yourself with the 4885A by reading the manual.

2. Check RS-232 connections carefully, use an oscilloscope to verify proper data flow and signal levels.

RS-232 Signal	Logic 1	Logic 0
Data	-5 to -25	+5 to +25
Control Signals	+5 to +25	-5 to -25

3. Use a Bus analyzer to verify 4885A's operation. Check simple commands against Table 3-4.

4. Verify instruments operation with a Bus analyzer or another controller.

5. Connect the instruments to the 4885A and exercise it with a simple program.

Use the Fault Isolation steps in Table 5-1 to narrow down the problem to a specific area. The majority of simple problems can be fixed by following the table and making minor corrections to the system hookup or program. Occasionally there will be a hardware fault with the 4885A. Call ICS for assistance or an RMA number before returning the unit to ICS for repair. If repairing the unit yourself, consult the spare parts list or Controller parts lists in Section 6.1 for correct part numbers and description when ordering any module, assembly or other replacement part.

The 4885A can perform self diagnostic testing by the use of the 12052 Test PROM Kit. The Test PROM Kit replaces the 4885A Controller PROMS with one programmed to check out each section of the controller. The serial I/O Board is tested by plugging the wrap-around connector (included with the kit) into J2. Test pass, fail and fault information is displayed on the front panel indicators. Refer to the instructions included in the Test PROM Kit for step-by-step checkout instructions.

An alternate method of detailed troubleshooting of a microprocessor based system like the 4885A Controller requires the use of a microprocessor analyzer in addition to the standard oscilloscope and VOM. The oscilloscope and VOM are excellent for troubleshooting static circuit elements such as the power supply, oscillator-clock driver, frequency selector and the serial drive and logic. The oscilloscope can even be used to troubleshoot data words and bits if the oscilloscope is sync'd to the respective word clock or strobe pulse line. Data flow should be tracked forward to find the defective IC, using either the oscilloscope or microprocessor analyzer. Data addresses are given in schematics by combining the ASX line with the decoded strobe to produce a 4 digit hex address = 0 + ASX + 0 + strobe number.

i.e., 4885A UART Received Data address is 0601. Signal ASG operates the decoder U 20, giving us the 06 part of the address. The UART's DRR (Data Received Register) line is connected to the decoder (U 20) 1 output to complete the address with an 01. Set this data address into the microprocessor analyzer to observe the frequency and data word at this point.

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[1] A microprocessor analyzers plugs into the microprocessor socket and lets the user observe the data flow to/from memory and I/O parts. A typical unit is the Model MPA-80/MPU-8080 manufactured by Current Electronic Design, Burbank, California 213/841/0434.

WARNING

IF THE FAULT ISOLATION PROCEDURE REQUIRES INTERNAL MEASUREMENTS, ALWAYS REMOVE POWER WHEN DISASSEMBLING OR ASSEMBLING THE UNIT. USE EXTREME CAUTION DURING TROUBLESHOOTING, ADJUSTMENTS, OR REPAIR TO PREVENT SHORTING COMPONENTS AND FURTHER DAMAGE TO THE UNIT.

TABLE 5-1 MODEL 4885A FAULT ISOLATION STEPS

Symptom	Possible Fault	Check
No power or no POWER light	Blown fuse	Fuse on rear panel
	115/230V Switch	Switch on rear panel
	AC power	Power cord plugged into rear panel and AC outlet
	Broken LED	Check LED, CR8
No lights	+5Vdc power	CR3,4 and Q1
	Broken LED	Check LED, CR8
READY light OFF	GP-1B control lines	ATN, EOI and IFC
	RS-232 status lines low	CC and CF inputs
	Microprocessor miss-start	Press RESET or turn POWER off for 10 seconds
	Loose part after shipment	Press PROMs, microprocessor and cable connectors and any socket mounted part

TABLE 5-1 MODEL 4885A FAULT ISOLATION STEPS - Continued

Symptoms	Possible Fault	Check
No command response	Wrong escape code	Escape switch on rear panel
		Input message error
	Bad connections	Wax on Bus connector
		Rear panel SOURCE switch position
		RS-232 input miswired
	Loose parts	Press all socket mounted parts firmly in place
	Wrong baud rate	4885A rear panel baud rate switch or sending unit setting
	Wrong character format	4885A's internal format switch or sending unit's format setting
	Wrong instrument address	Instrument address setting
		Address or ASCII code used in program
	Inoperative instrument	Check instrument with Bus analyzer
		Verify instrument programming sequence with instrument manual
		Verify instrument control settings
	4885A in standby	STANDBY switch in out position

TABLE 5-1 MODEL 4885A FAULT ISOLATION STEPS - Continued

Symptoms	Possible Fault	Check
Partial command response	Command format	4885A's formats
		Instrument manual for command format
	Dual instrument address	Instrument for different Talk and Listen addresses
	Instrument misprogrammed	Instrument manual for correct programming sequence
	Instrument not reset after last data message	Instrument data output message not restarting - check with a Bus analyzer
		Instrument manual for reset command
LISTENING light on	Wrong talk address	User's program
		Instrument address
	No data received	Input device not ready or not commanded
	Controller has not received Terminating character	Check input device and Bus for carriage return or EOI at end of data
TALKING light on	No device handshake	Output Device holding Bus
	Wrong listen address	User's program
		Instrument address
	Bus hang up	Bus analyzer speed in single step.
		Other bus devices busy

TABLE 5-1 MODEL 4885A FAULT ISOLATION STEPS - Continued

Symptom	Possible Fault	Check
No serial input	Open line	SOURCE switch position
	Bit rate	Baud rate setting
	Character Format	Character Format setting
No serial output	No output data received	Never in Listen Mode See LISTENING above
	CB Missing	RS-232 Device actually acknowledges 4885A's CA with CB
	CC or CF Missing	Cable, receiving device
	Device Missing data or Garbled Data	Wrong baud rate or character format setting
4885A outputting extra CR's or LF's on serial port	Instrument not resetting with untalk and outputting extra CR or LF	Bus data with Bus analyzer
		Instrument manual on resetting instrument Talk format
		Instrument manufacutrer for instrument characteristics
	Computer unable to process both CR and LF on end of 4885A message	4885A rear panel CR/CRLF switch position

5.4 LOGIC CONVENTIONS

The unit used positive logic, which means the normally active or high signal state is +3.5 $\pm$ 1 volts and the inactive or low state is 0 $\pm$0.5 volt. The high state is referred to as logic 1 and the low state is logic 0. The terms true and false relate to the signal being in or out of its active state and normally correspond to logic 1 and 0. However, for some signals such as the input of a OR gate, the true or active state is the low signal level (0 volts).

Complements of signals are indicated by an F or N suffix or by an inversion dot on the logic symbol. Complements of signals are indicated by an F or N suffix or by an inversion dot on the logic symbol. Complemented signals are always low when the original signal is high and vice versa. See Figure 5-1 for the standard logic symbols.

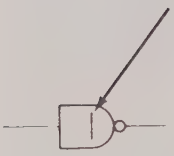
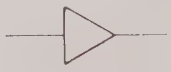
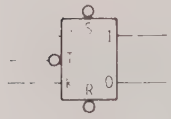
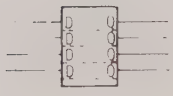
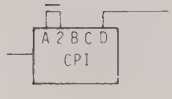
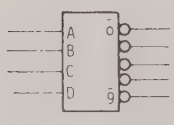
o	Inversion dot	Part of a larger symbol. Indicates that the input or output signal is low when in the active or true state.
	Open collector bar	Bar on output indicates an open collector device without an internal signal pullup.
	NAND gate	Performs the NOT-AND function. Output is low when all inputs are high.
	NOR gate	Performs the NOT-OR function. Output is high when one or more inputs are low.
	Wired OR	Performs an OR function using only chassis wires. Output low when one or more inputs are low.
	Amplifier, (level shifter or inverter)	Performs signal current amplification or level shift function. Signal polarities shown by inversion dots.
	Inverter	Performs a logic signal inversion; always used with the inversion dot.
	Clocked Flip-Flop	Output changes state on negative edge of clock if J and/or K was true during clock time. Outputs set or reset if either Preset or Reset input grounded.
	Quad Latch	Four D or storage flip-flops in single package. Normally has both Q and $\overline{Q}$ outputs. Data loads while clock high, latched when low.
	Counter	Four cascaded flip-flops in a single package designed as a counter. Divides by 10, 12 or 16. Check an IC catalog for reset, clear and load signal definitions.
	Decoder	Four line BCD to ten line decimal decoder. Outputs low when active.

Figure 5-1 Standard Logic Symbols

6

Parts List and Location

6.1 INTRODUCTION

This section contains all information necessary to locate, identify, and order parts. The listing of parts and information for an exact replacement are shown in the attached parts list. All components locations are identified by reference designators in the parts list and in the attached circuit board assembly drawings. Layouts for the units circuit boards are shown in Figures 6-2 thru 6-4.

6.2 REPLACEMENT PARTS

6.2.1 Standard Parts

All parts can be purchased directly from ICS Electronics Corporation, at current market price, plus a handling charge. However, since most parts are standard electronic components, it is suggested that they be secured locally for prompt replacement. The parts list gives all pertinent information including the recommended manufacturers. Where not noted, equivalent parts meeting the original part specifications may be substitued. A list of manufacturers by abbreviations is given in Table 6-1 and recommended spare parts in Table 6-2.

6.2.2 Special Parts

Parts marked with a Data Works, Fairchild Instrumentation, or an ICS part number should be procured directly from ICS Electronics Corporation. These parts are manufactured or selected to satisfy specific requirements. Substitution of other parts might not yield equivalent performance and will void any warranty.

6.2.3 Parts Ordering Information

All orders should be directed to ICS Electronics Corporation, at the address shown on the front page, or to ICS Electronics in care of your local representative. When ordering, be sure to include the following information:

a. Part description and reference designator
b. Part number, manufacturer, and stock number
c. Instrument model, serial number, and program revision level.

TABLE 6-1 LIST OF MANUFACTURERS BY ABBREVIATIONS

Abbreviations	Company
ABC	Allen Bradley, Milwaukee, WI
AEP	Alco Electronic Products, Inc., Lawrence MA
AMA	Amaton, New Haven, CT
AMD	Advanced MicroDevices, Sunnyvale, CA
AMP	Amp Incorporated, Harrisburg, PA
ANS	Ansley Electronics Corp., Los Angeles, CA
APH	Amphenol Corp., Oakbrook, IL
ARC	Arco, Commack, NY
ARI	Aries Industries, Inc., Gardena, CA
AUG	Augat Inc., Attleboro, MA
BEC	Beckman, Heliport Division, Fullerton, CA
BEL	Belden Corp., Richmond, VA
BOR	Bourns, Riverside, CA
BUD	Budwig, Los Angeles, CA
BUS	Bussmann, Earth City, MO
CAC	Circuit Assembly Corporation, Costa Mesa, CA
CDE	Cornell Dublier, Newark, NJ
CEL	Cellotape, Sunnyvale, CA
CHY	Cherry Electrical Products Corp., Highland Park, IL
CJO	Cinch Manufacturing Co., Elk Grove Village, IL
CMS	Component Manufacturing Service, Bridgewater, MA
CNT	Centralab, Los Angeles, CA
COR	Corcom Inc., Chicago, IL
CRN	Corning Glass Works, Corning, NY
CTS	CTS Corporation, Elkhart, IN
DAL	Dale Electronics Incorporation, Columbus, NB
DIA	Dialco, Brooklyn, NY
DWI	Data Works Instrumentation, (See ICS)
EPI	Epitek, Kanata, Ontario, Canada
ERI	Erie Technological Products, Erie, PA
EXL	Excel, Chicago, IL
FCL	Freedom Crystal Lab, Freedom, CA
FIS	Fairchild Inst. & Controls Div., (See ICS)
FSC	Fairchild Semiconductor Div., Mountain View, CA
GHI	Grayhill, La Grange, IL
HEY	Heyboer, Grand Haven, MI
HHS	Herman H. Smith, Inc., Brooklyn, NY
HP	Hewlett-Packard

TABLE 6-1 LIST OF MANUFACTURERS BY ABBREVIATIONS (Continued)

Abbreviations	Company
ICS	ICS Electronics Corporation, San Jose, CA
IER	IERC, Burbank, CA
INL	INTEL, Sunnyvale, CA
IRC	TRW/IRC Resistors, Philadelphia, PA
ITT	ITT General Controls, Glendale, CA
KEM	Kemet, Greenville, SC
KOS	Koszeigi, South Bend, IN
LFS	Little Fuse Inc., Des Plaines, IL
LOP	Zollin J. Lopaugh, San Francisco, CA
LYN	Lyntron, Inc., Burbank, CA
MED	Meadows Manufacturing, Sunnyvale, CA
MIN	Minicomputer Accessories, Sunnyvale, CA
MLX	Molex Products Co., Downers Grove, IL
MON	Monsanto, Palo Alto, CA
MOT	Motorola Semiconductor Products, Inc., Phoenix, AZ
MSC	Master Specialities Co., Costa Mesa, CA
NAT	National Semiconductor Ltd., Plattsburgh, NY
NIC	Nichicon, Chicago, IL
PAN	Panduit, Tinley Park, IL
PCL	Precision Crystal Lab, Santa Monica, CA
PNS	Panasonic, Secaucus, NJ
RAY	Raytheon, Mountain View, CA
RCH	Richlock, Chicago, IL
RGA	RG Allen, Van Nuys, CA
SAE	Stanford Applied Engineering, Long Beach, CA
SCN	Scanbe, El Monte, CA
SEK	Seiko Circuits, Sunnyvale, CA
SHO	Shoin, Japan
SIG	Signetics Corp., Sunnyvale, CA
SPR	Sprague Electric., Chicago, IL
SWC	Switchcraft, Inc., Chicago, IL
TEM	Temple Industries, Inc., Tecate, CA
THC	Thermalloy Co., Dallas, TX
TI	Texas Instruments, Semiconductor Div., Dallas, TX
USE	USECO, Van Nuys, CA
VIK	Viking, Chatsworth, CA
WDC	Western Digital Corp., Newport Beach, CA
WFD	Wakefield Engineering, Inc., Wakefield, MA

6.3 PARTS LISTS

The parts list (Table 6-3) contains all components and sub-assemblies that make up the unit. Subsequent Tables 6-4 and 6-5 break the main board assembly (A1) down to the component level. Table 6-6 breaks the I/O Board Assembly (A2) down to the component level. Table 6-7 covers the Memory Expansion Module (A-3).

The parts list tables contain both the ICS Electronics Corporation stock numbers and the manufacturers' true part numbers where applicable. True manufacturers' part numbers are not shown for industry standard parts nor items unique to the 4885 Controller.

TABLE 6-2 4884/5A RECOMMENDED SPARE PARTS LIST

For assembly level sparing order the following: Item 1 or 2, Item 3, 4, and Item 5A or 5B.

For component level sparing, items 5 through 42 may be ordered separately or together in kit form as 4884/5 Spare Parts Kit, P/N 111253, (see item 44). Refer to Stock Number when ordering from ICS Electronics.

Item	Qty.	Mfgr.	Part Number	Description	Stock No.
1	1	ICS	112202	Assy. Main Board	112202
2	1	ICS	112204	Assy. Main Board Less Rear Panel	112204
3	1	ICS	112206	Assy., Serial I/O Card	112206
4	1	ICS	12096	Assy., Memory Exp.	112096
5A	5	LFS	313001	Fuse 3AG 1 Amp	900002
5B	5	LFS	313000.5	Fuse 3AG 1/2 Amp	900001
6	1	ICS	10079	Transformer	125000
7	1	GHI	76B08	Switch, Rocker 8 Posn.	907011
8	1	ICS	125005	Switch 3 Posn.	125005
9	1	FSC	UA7805	Regulator +5V	730340
10	1	FSC	UA7905	Regulator -5V	737905
11	1	FSC	UA7812	Regulator +12V	737812
12	2		IN4001	Diode, 50V, 1A	714001
13	2	MOT	MR 502	Diode, 200V, 3A	710502
14	2	FSC	FLV160	LED, RED	710160
15	1	ICS	904001	Crystal 14.745 MHz	904001
16	1	AMD	8080A	Microprocessor	798080
17	1	ICS	2708	PROM, with 4885 Program	792708
18	1	AMD	74LS138	IC, DCDR	742138
19	1		74LS13	IC,Schmitt Trig.	742013
20	1		74LS04	IC, Hex Inv.	742004
21	1	AMD	2112A-04	RAM 4 x 256	792112
22	1	SIG	8T97	IC, DVR	738097
23	1		74LS197	IC ÷16	742197
24	1		74LS00	IC, QUAD NAND	742000
25	2		74LS03	IC, QUAD NAND	742003
26	1		74LS74	IC, D F/F	742074
27	1		74LS10	IC, 3 INput NAND	742010

*See ICS's latest 4884/5 Recommended Spare Parts list for current prices.

TABLE 6-2 4884/5 RECOMMENDED SPARE PARTS LIST
(Continued)

Item	Qty.	Mfgr.	Part Number	Description	Stock No.
28	1		7406	IC, Hex DVR	740006
29	2		74LS75	IC, QUAD Latch	742075
30	1		7438	IC, DVR	740038
31	1		74107	IC, JK F/F	742107
32	1	ABC	316E302622	RES. NET 3K/6.2K	697002
33	1	DAL	898-1-R3.3K	RES. NET 3.3K	697001
34	1		2N3906	Transistor, PNP	723906
35	1	FSC	UA7912	Regulator, -12V	737912
36	1	GHI	76B05	Switch, Rocker, 5 Posn.	907010
37	1	MOT	1489P	IC, RS-232 Rcvr.	731489
38	1		74125	IC, Tristate Buffer	740125
39	1		74151	IC, MUX	742151
40	1	MOT	1488P	IC, RS-232 DVR	731488
41	1		74LS93	IC, ÷16 CTR	742093
42	1		74LS08	IC, QUAD AND	742008
43	1	WDC	TR1602B	IC, UART	791863
44	1	ICS	-	4885 Spare Parts Kit (includes items 5A, 5B)	111253

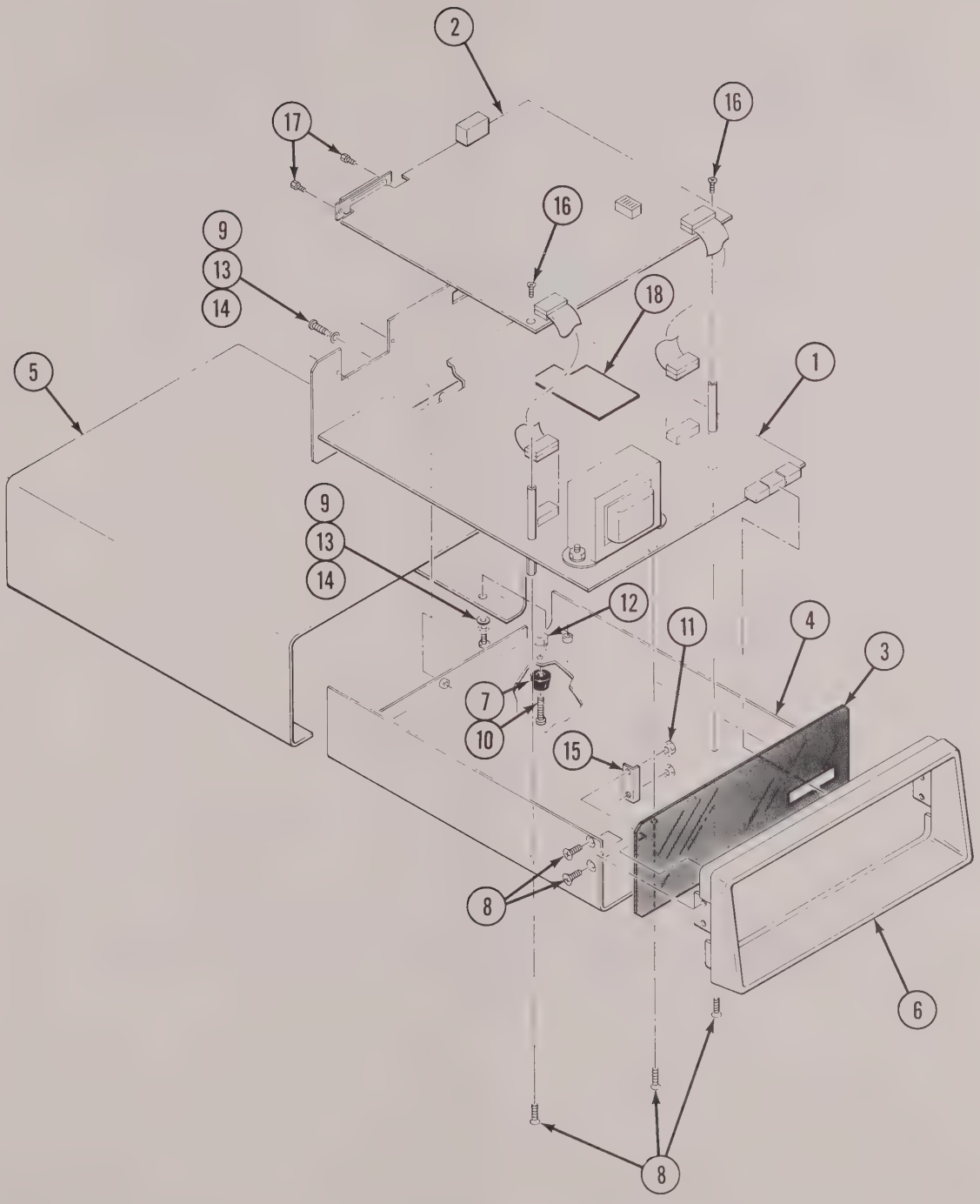


Figure 6-1 4885A Controller Exploded Assembly

TABLE 6-3 4885A RS-232 CONTROLLER - PARTS LIST

Identification No.	Stock Number	Qty. Per Assem.	Description	Ref.	Mfgr.	Mfgr.P/N
1	112202	01	ASSY MAIN BOARD	A1		
2	112206	01	ASSY, RS-232 I/O BOARD	A2		
3	112033	01	FRONT PANEL			
4	112237	01	BASE PLATE			
5	112238	01	COVER			
6	112239	01	BEZEL			
7	908000	04	FOOT, MTG			
8	412603	08	SCREW, #6-32 x 3/8 FH			
9	411803	05	SCREW, #8-32 x 3/8 PH			
10	411404	04	SCREW, #4-40 x 1/2 PH			
11	422600	04	KEPNUT, #6			
12	422400	04	KEPNUT, #4			
13	431800	05	WASHER, SPLIT-LOCK, #8			
14	430800	05	WASHER, FLAT, #8			
15	112258	02	CLIP, RETAINING			
16	411603	02	SCREW, 6 X 32 X 3/8, PH			
17	490005	02	STUD, FEMALE LOCKING	(J2)	CJO	BD-20418-2
18	112096	01	ASSY, MEMORY EXP. MODULE	A3		
19	112001	01	LABEL			

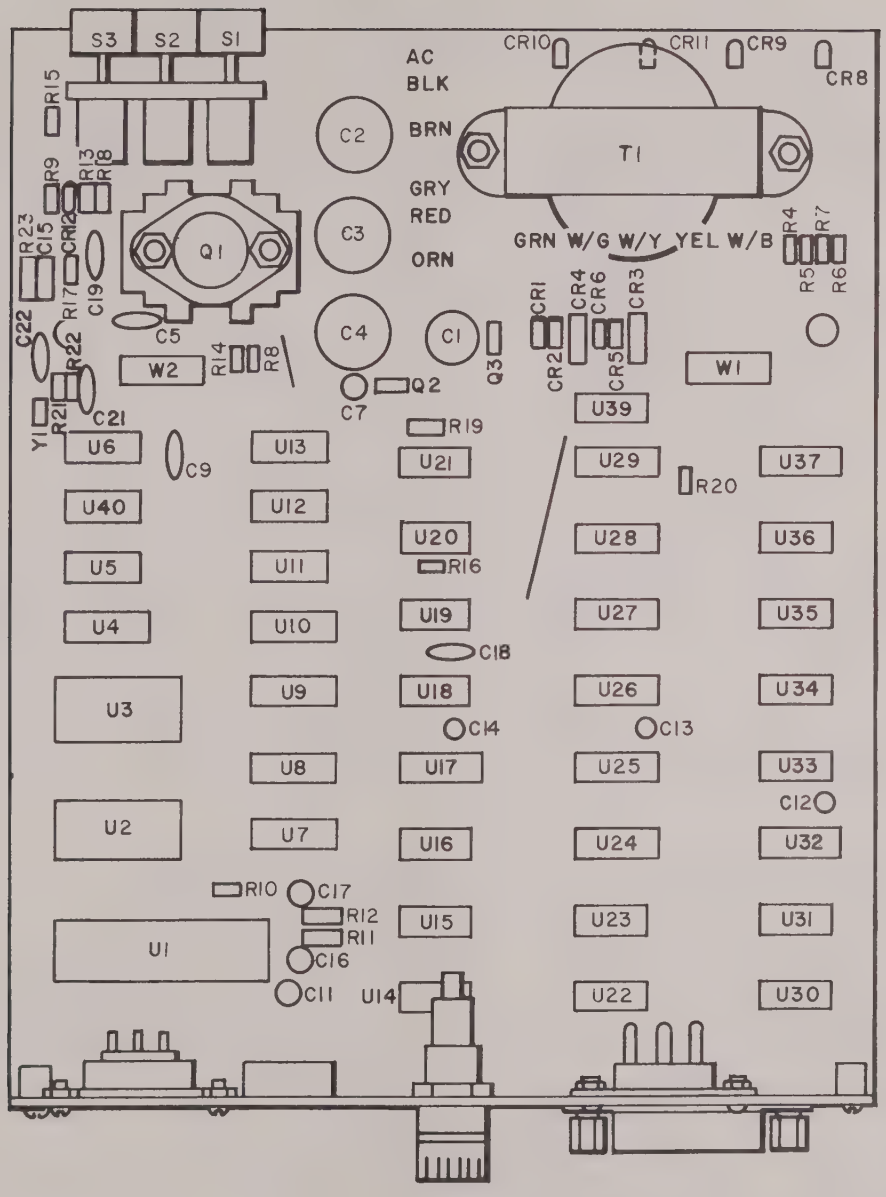


Figure 6-2 Assembly 4885A Main Board

TABLE 6-4 4885A MAIN BOARD PARTS LIST

Stock Number	Qty. Per Assem.	Description	Reference	Mfgr.	Mfgr.P/N
907012	01	SWITCH, SLIDE 115/230VAC	S4		
902009	01	RECEPTABLE, AC, POWER	J4		
112257	01	CABLE, HARNESS			
411404	04	SCREW 4-40 x 1/2 PH, PHL	(S4), (J4)		
421400	04	NUT #4 SMALL PATTERN	(S4), (J4)		
431400	04	LOCKWASHER #4	(S4), (J4)		
112036	01	REAR PANEL			
112204	01	4880 ASSY-PCB			
900002	01	FUSE, 3AG, 1 AMP	F1	LFS	313001
901001	01	FUSEHOLDER, 3AG	XF1	LFS	342004
490001	02	MTG STUD, STANDOFF, (M)	(J1)	ICS	0380-0643

TABLE 6-5 PC BOARD ASSEMBLY PARTS LIST

Stock Number	Qty. Per Assem.	Description	Reference	Mfgr.	Mfgr.P/N
111004	01	P.C. BOARD			
905003	01	TRANSFORMER, 10079	T1		
125005	01	SWITCH ASSY, 3 POSN	S1-3		
907011	01	SWITCH, ROCKER, 8 POSN	S5	GHI	76B08
903005	01	SOCKET, 16 PIN, RT ANGLE	(S5)	AUG	516-AG 7D
902004	01	CONNECTOR, 24 PIN	J1	APH	57-20240-2
906001	01	HEATSINK	(Q1)	IER	LAT03B5CB
730340	01	REG., UA7805, POS, +5V	Q1		
737905	01	REG., UA7905, NEG, -5V	Q2		
737812	01	REG., UA7812, POS, +12V	Q3		

TABLE 6-5 PC BOARD ASSEMBLY PARTS LIST
(Continued)

Stock Number	Qty. Per Assem.	Description	Reference	Mfgr.	Mfgr.P/N
714001	05	DIODE, IN4001, 50V, 1A	CR1,2,5,6		
710502	02	RCTFR, MR502, 200V,3A	CR3,4	MOT	
710160	04	LED, RED	CR8-11	FSC	FLV160
904001	01	CRYSTAL, 14.745 MHz, PC 18	Y1		
564207	01	CAP, ELEC, 200UF, 35V	C1	TEM	411-200-35
562152	03	CAP, ELEC, 1500UF, 15V	C2-4	TEM	411-1500-15
535104	03	CAP, CERAMIC, 0.1UF, 50V	C5,9,10	ERI	8121-050-L51-104M
521475	05	CAP, TANT, 4.7UF, 10V	C7, 11-14	ITT	TAG-F20-4.7-10/50
514276	01	CAP, TANT, 27UF, 35V	C15		CSR13C276KL
522106	02	CAP, TANT, 10UF, 16V	C16,17	ITT	TAG-F20-10-16
539102	01	CAP, DISK, .001 UF	C18	ERI	831-000-YSFO-102X
533103	01	CAP, DISK, .01 UF	C19	ERI	5835-000-Y5U0-103E
523105	00	CAP, TANT, 1.0 UF, 35V	C20	ITT	TAG-F20-10-35
548240	02	CAP., 24 PF, 500V	C21, C22		
602222	03	RES, 2.2K, 1/4W 5%	R21-22,16		RC07GF222J
602161	05	RES, 160 , 1/4W 5%	R4-7,17		RC07GF161J
602333	06	RES, 33K, 1/4W 5%	R8,9,10,14 15,19		RC07GF333J
603331	02	RES, 330 , 1/2W 5%	R11,12		RC07GF104J
602104	02	RES, 100K, 1/4W 5%	R13		RC07GF104J
602224	01	RES, 220K, 1/4W 5%	R18		RC07GF224J
602103	01	RES, 10K, 1/4W 5%	R20		RC07GF103J
798080	01	9080A/P8080A	U1	AMD	
792708	01	2708	U2	FSC	
742138	02	74LS138	U4, U17	AMD	
742013	01	74LS13N	U5		

TABLE 6-5 PC BOARD ASSEMBLY PARTS LIST
(Continued)

Stock Number	Qty. Per Assem.	Description	Reference	Mfgr.	Mfgr.P/N
742004	02	74LS04N	U6, U16		
738097	02	8T97	U9, U10	SIG	
742197	01	74LS197N/9LS197N	U11		
742002	02	74LS02N/9LS00N	U13, U19		
742003	06	74LS03N/9LS03N	U14-15, U22-23, U30-31		
741074	01	74S74N/9S74N	U18		
742010	02	74LS10N/9LS10N	U20, U12		
740006	01	7406N	U21		
697002	02	RES, NET, 3.3K, 6.2K	U24, U32	ABC	316E302622
742075	05	74LS75N/9LS75N	U25-29		
740038	05	7438N	U33-36, U39		
697001	01	RES, NET, 3.3K	U37	DAL	898-1-R3.3K
742107	01	74LS107N/9LS107N	U40		
441607	04	SPACER, MALE-FEMALE	(T1)		
422600	04	KEPNUT #6	(T1) (Q1)		
430800	04	WASHER, FLT. #8	(T1) (Q1)		
411604	04	SCREW, 6 X 32 X 1/2, PH,PHL			
903006	04	SOCKET, 16 PIN	(U7, 8) (W1, 2)		
903007	02	SOCKET, 24 PIN	(U2, 3)		
903008	01	SOCKET, 40 PIN	(U1)		
442612	02	STANDOFF, SWG, 1-1/2 X 6-32	NONE	LYN	L6910-24-3C
490003	02	CHASSIS, FASTENERS	NONE	USE	1590C11

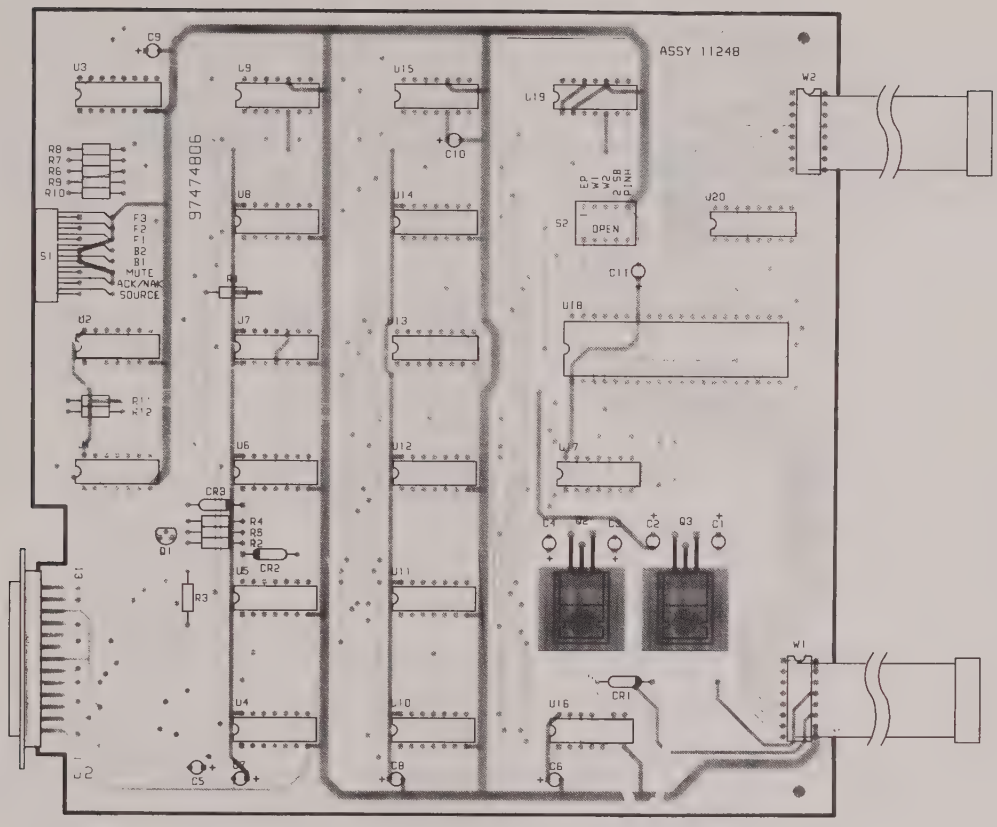


Figure 6-3 Assembly 4885A RS-232 I/O Card

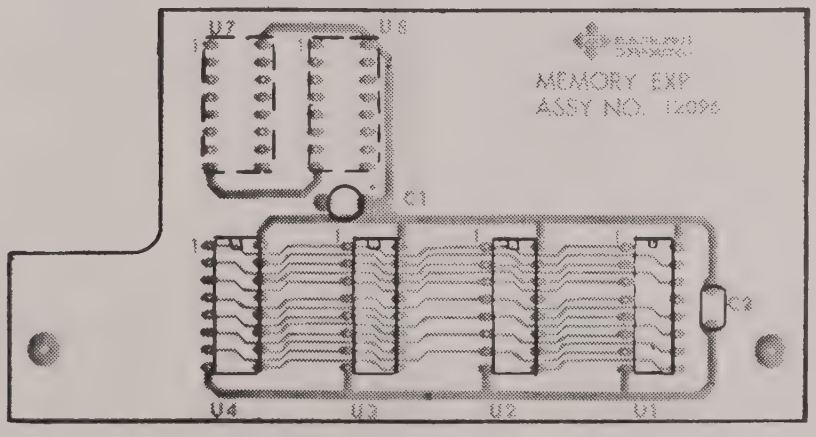


Figure 6-4 Assembly, Memory Expansion Module

TABLE 6-6 4885A SERIAL I/O CARD - PARTS LIST

Stock Number	Qty. Per Assem.	Description	Reference	Mfgr.	Mfgr.P/N
122208	01	P.C. BOARD			
521053	04	CAP, TANT, 1 UF, 35V	C1,2,3,4	ITT	TAG-F20-1-35/50
523474	01	CAP, TANT, .47 UF, 35V	C5	ITT	TAG-F20-0.47-35/50
521475	06	CAP, TANT 4.7 UF, 10V	C6-11	ITT	TAG-F20-4.7-10/50
714001	03	DIODE, IN4001	CR1, 2, 3		
602273	01	RESISTOR, 27K, 1/4W, 5%	R2		RC07GF273J
602103	01	RESISTOR, 10K, 1/4W, 5%	R3		RC07GF103J
602152	01	RESISTOR, 1.5K, 1/4W, 5%	R4		RC07GF152J
602101	01	RESISTOR, 100 , 1/4W, 5%	R5		RC07GF101J
602333	08	RESISTOR, 33K, 1/4W, 5%	R1, R60 R12		RC07GF333J
723906	01	TRANSISTOR, PNP, 2N3906	Q1		
737812	01	REG., +12V	Q2	FSC	UA7812
737912	01	REG., -12V	Q3	FSC	UA7912
902000	01	CONNECTOR, 25 SOCKET	J2	CJO	DB-25S
110103	02	CABLES, FLAT RIBBON, 16 CON	W1,W2		
907011	01	SWITCH, ROCKER 8 PST	S1	GH1	76B08
907010	01	SWITCH, ROCKER 5 PST	S2	GH1	76B05
903005	01	SOCKET, 16 PIN RT. ANGLE	(S1)	AUG	516-AG 7D
903008	01	SOCKET, 40 PIN	(U18)		
731489		1489P	U1, U4	MOT	
740125	03	74125	U2,U14,U17		
742151	01	74LS138	U3	AMD	
731488	01	RS-232 DVR, 1488P	U5	MOT	
742093	03	74LS93/9LS93	U9,U15,U19		
742008	01	74LS08/9LS08	U8		

TABLE 6-6 4885A SERIAL I/O CARD - PARTS LIST
(Continued)

Stock Number	Qty. Per Assem.	Description	Reference	Mfgr.	Mfgr.P/N
742000	04	74LS00/9LS00	U6,U10,U12 U16		
742004	01	74LS04/9LS04	U11		
742075	01	74LS75/9LS75	U13		
742074	01	74LS74/9LS74	U7		
791863	01	UART, 1863B	U18		
742138	01	74LS138/138	U20		

TABLE 6-7 4880 MEMORY EXPANSION MODULE - PARTS LIST

Stock Number	Qty. Per Assem.	Description	Reference	Mfgr.	Mfgr.P/N
112098	01	PCB	-	-	-
521475	01	CAP, TANT, 4.7UF, 10V	C1	ITT	TAG-F20-4.7-10/50
533105	01	CAP, DISK, .01UF, 25V	C2	ERI	
792112	04	RAM, 256 x 4	U1-U4	INL	2112-4

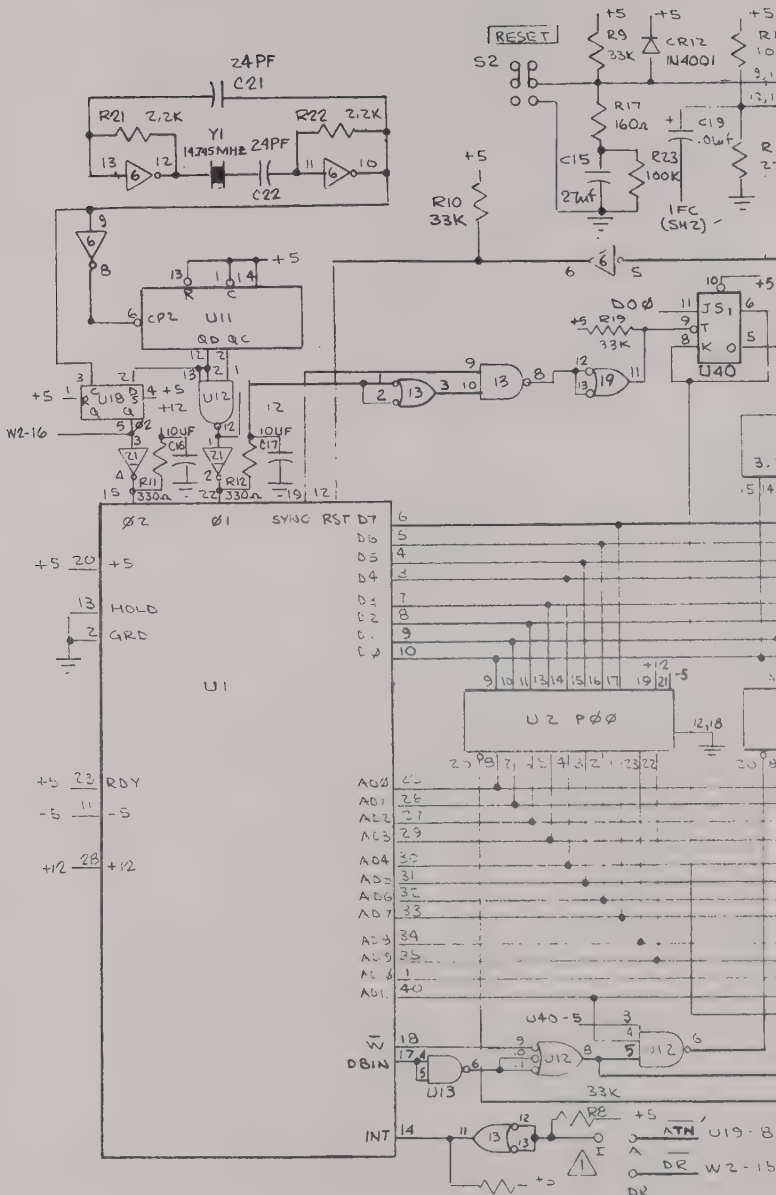
7

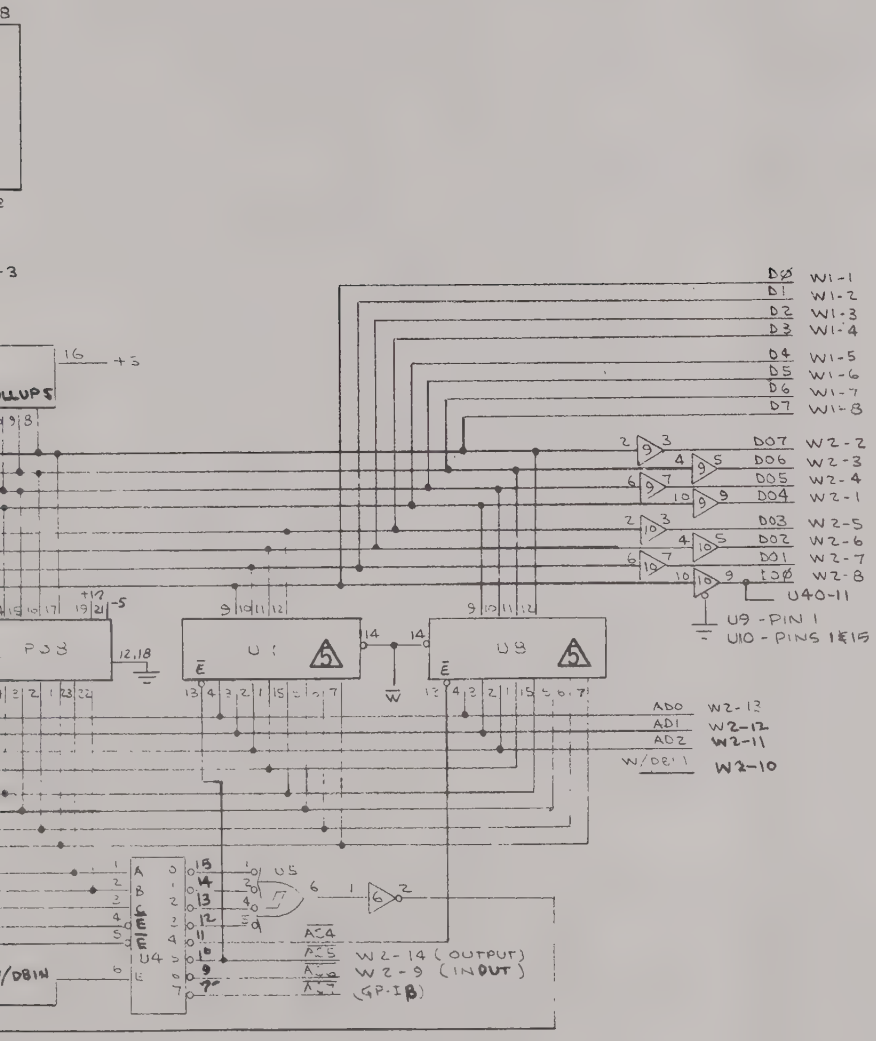
Drawings, Diagrams, Wire Lists

DRAWINGS, DIAGRAMS, WIRE LISTS

This section includes the following figures:

7-1 Model 4885A Main Board Logic Diagram
7-2 Model 4880 Memory Expansion Module Logic Diagram
7-3 Model 4884/5A Serial I/O Logic Diagram

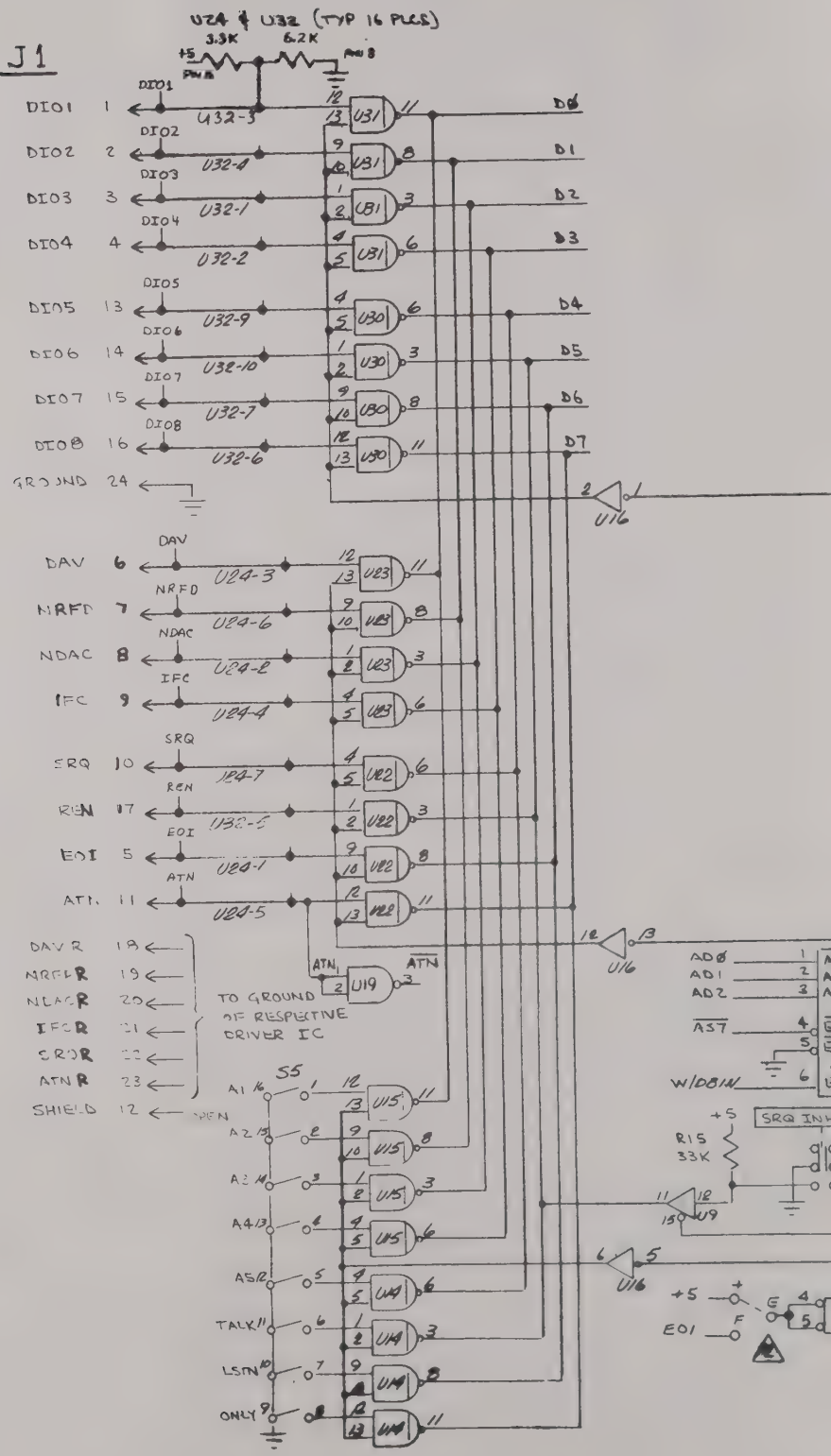

RESET
S2
+5
R9
33K
CR12
IN4001
R17
160Ω
C19
.01uf
C15
.27uf
R23
100K
1FC
(SHZ)
R10
33K
24PF
C21
R21 2.2K
R22 2.2K
Y1
14.745MHz
24PF
C22
U11
CP2
U18
U12
W2-16
10UF
C16
C17
R11
330Ω
R12
330Ω
U40
JS1
R19
33K
U1
Ø2
Ø1
SYNC
RST
D7
HOLD
GRD
RDY
-5
+12
U2 PØØ
ADØ
AD1
AD2
AD3
AD4
AD5
AD6
AD7
AD8
AD9
AD10
AD11
W
DBIN
INT
U40-5
U12
U13
33K
R8
R14 33K
ATN
DR
U19-8
W2-15



NOTES:

5. 4884 & 4885's - U7 AND U8 REPLACED BY MEMORY EXPANSION MODULE
4. 4885 ONLY
3. C6,C8 NOT USED
2. JUMPER E TO + FOR USE, WITH TEKTRONIX 4051 (STD)
   JUMPER E TO F TO ENABLE PARALLEL POLL LOGIC
1. JUMPER I TO A FOR MODELS 4881 THRU 4883
   JUMPER I TO DR FOR MODEL 4884

Figure 7-1 Model 4885A Main Board Logic Diagram


J1
U24 & U32 (TYP 16 PLCS)
3.3K
6.2K
+5
PIN 8
PIN 8
DIO1
DIO2
DIO3
DIO4
DIO5
DIO6
DIO7
DIO8
GROUND
U32-3
U32-4
U32-1
U32-2
U32-9
U32-10
U32-7
U32-6
U31
U30
U29
D0
D1
D2
D3
D4
D5
D6
D7
U16
DAV
NRFD
NDAC
IFC
SRQ
REN
EOI
ATN
U24-3
U24-6
U24-2
U24-4
U24-7
U32-5
U24-1
U24-5
U23
U22
DAV R
NRFD R
NDAC R
IFC R
SRQ R
ATN R
SHIELD
TO GROUND OF RESPECTIVE DRIVER IC
U19
ATN
A1
A2
A3
A4
A5
TALK
LSTN
ONLY
55
OPEN
U15
U14
ADØ
AD1
AD2
A37
W/DBIN
SRQ IN
R15
33K
U9
+5
EOI

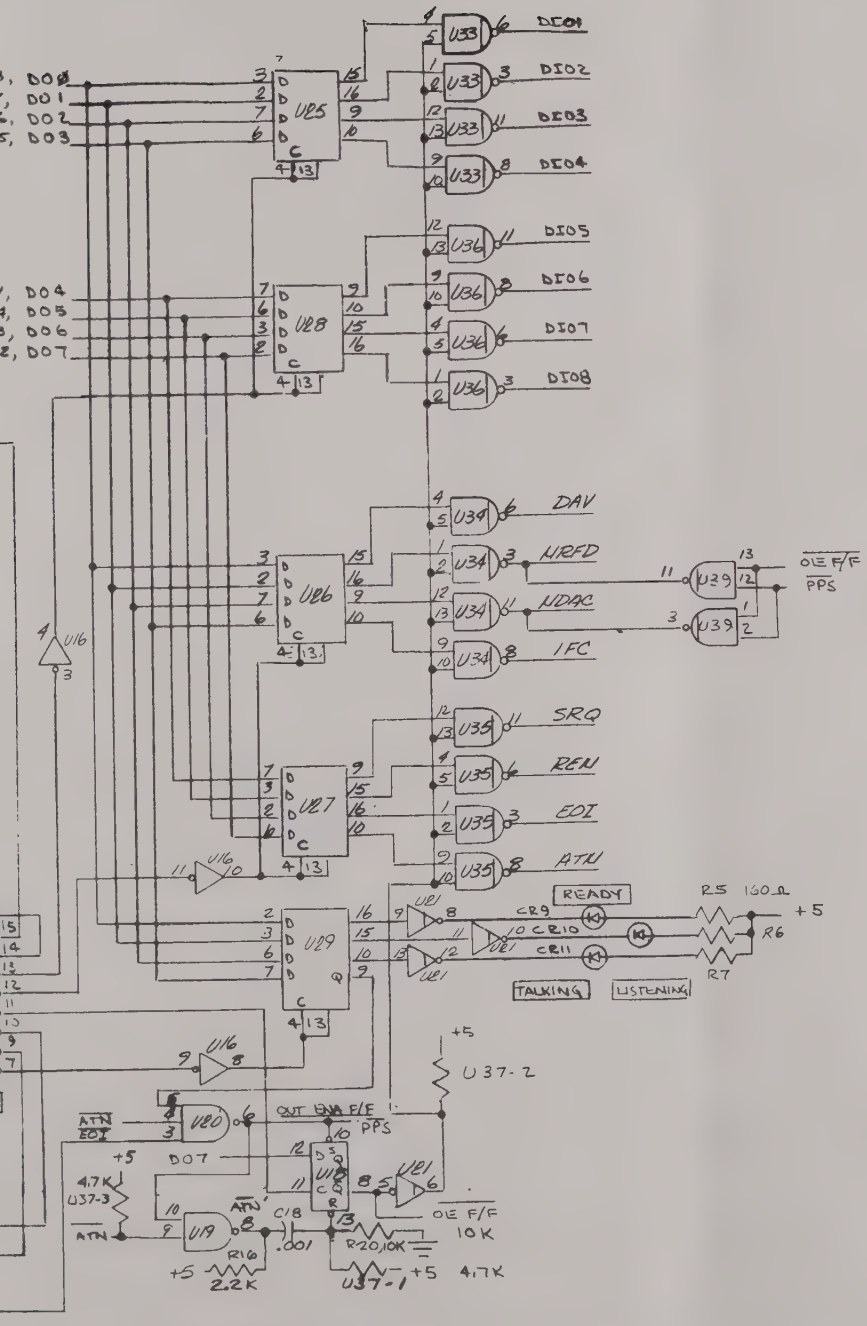
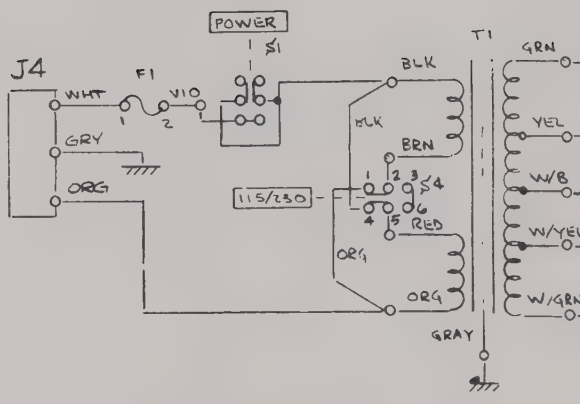


Figure 7-1 Model 4885A Main Board Logic Diagram (Continued)


POWER
S1
T1
J4
F1
WHT
VIO
GRY
ORG
BLK
BLK
BRN
115/230
RED
ORG
ORG
GRN
YEL
W/B
W/YEL
W/GRN
GRAY

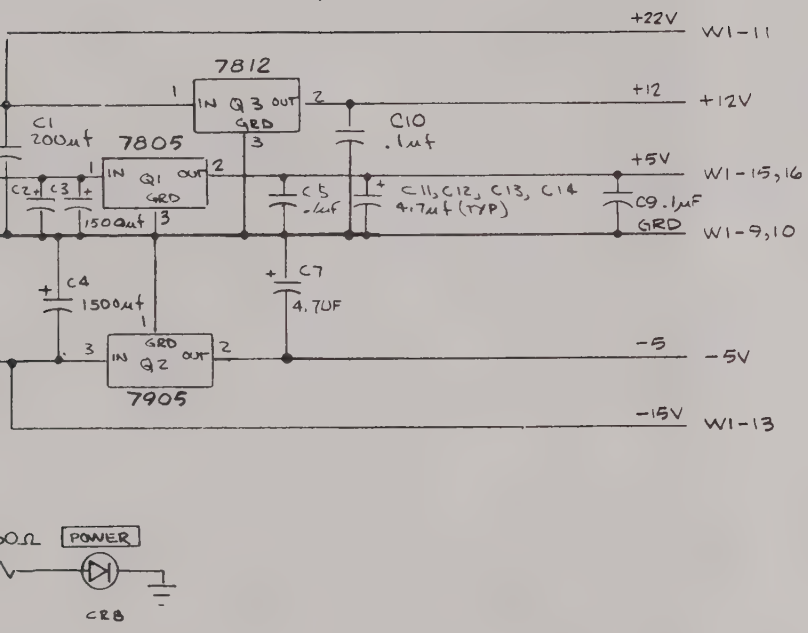
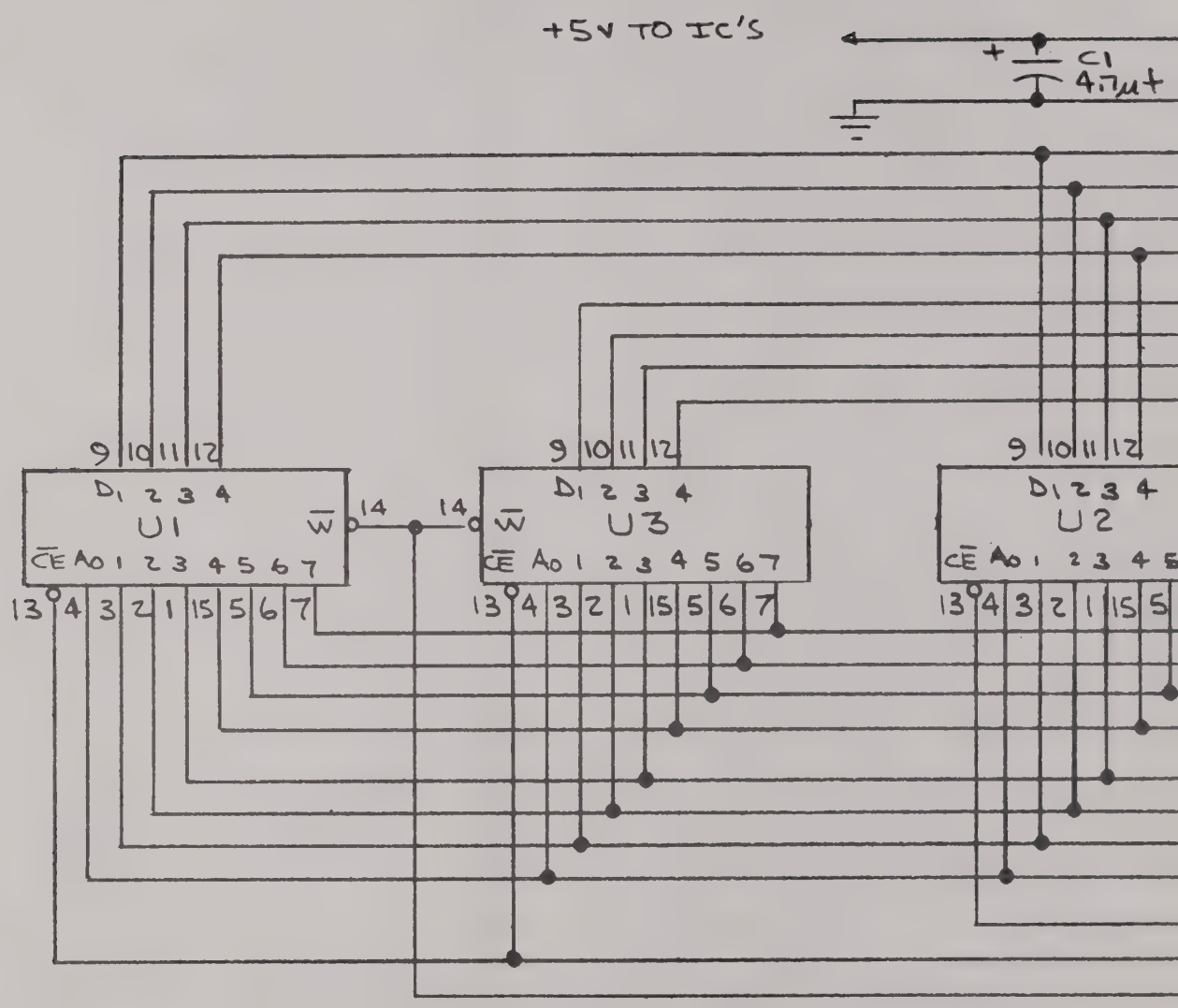


Figure 7-1 Model 4885A Main Board Logic Diagram (Continued)


+5V TO IC'S
+
C1
4.7μf
9 10 11 12
D1 2 3 4
U1
W
14
CE A0 1 2 3 4 5 6 7
13 4 3 2 1 15 5 6 7
14
W
U3
U2

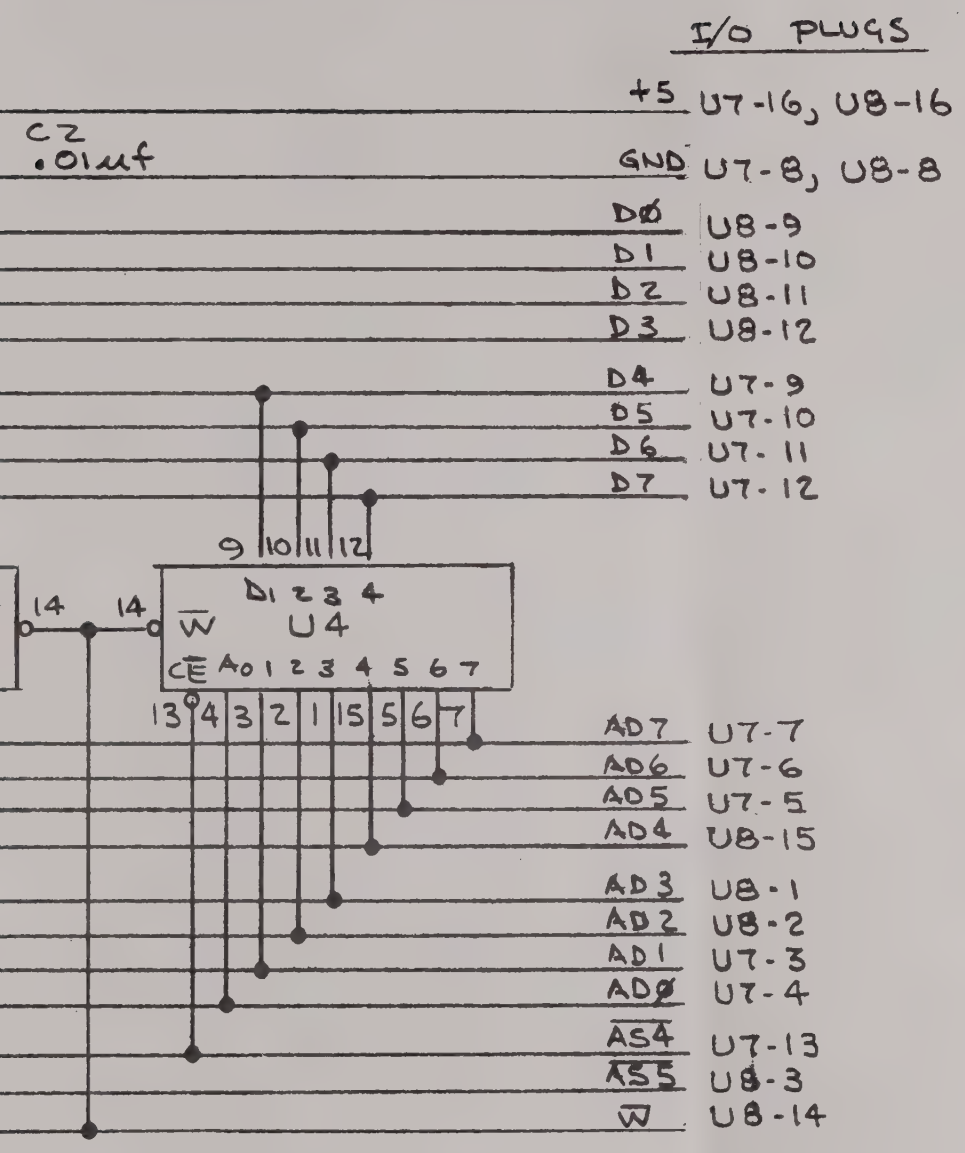
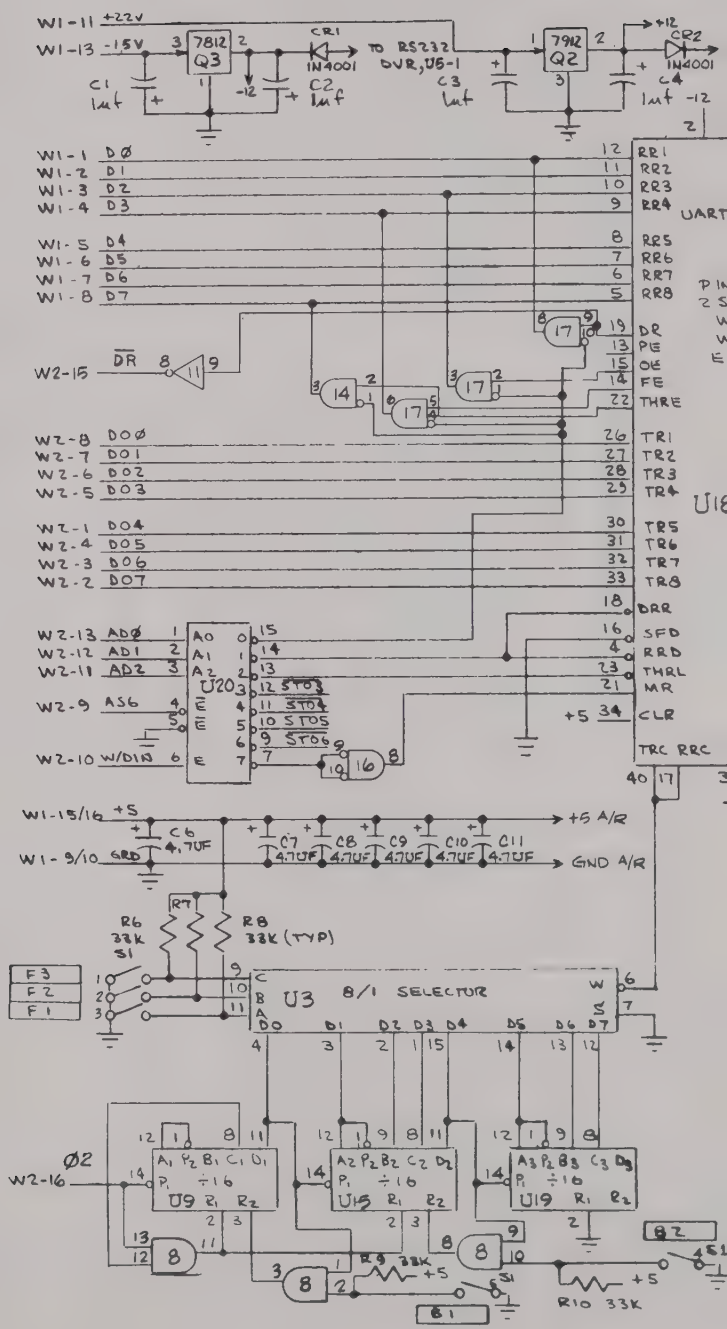


Figure 7-2 Model 4880 Memory Expansion Module Logic Diagram


W1-11 +22V
W1-13 -15V
7812 Q3
7912 Q2
CR1 IN4001
TO RS232 DVR, US-1
CR2 IN4001
C1 1uf
C2 1uf
C3 1uf
C4 1uf
W1-1 D0
W1-2 D1
W1-3 D2
W1-4 D3
W1-5 D4
W1-6 D5
W1-7 D6
W1-8 D7
RR1
RR2
RR3
RR4
RR5
RR6
RR7
RR8
UART
DR
PE
OE
FE
THRE
W2-15 DR
W2-8 D00
W2-7 D01
W2-6 D02
W2-5 D03
W2-1 D04
W2-4 D05
W2-3 D06
W2-2 D07
TR1
TR2
TR3
TR4
TR5
TR6
TR7
TR8
W2-13 AD0
W2-12 AD1
W2-11 AD2
W2-9 AS6
W2-10 W/DIN
U20
STO3
STO4
STO5
STO6
DRR
SFD
RRD
THRL
MR
CLR
+5
TRC RRC
W1-15/16 +5
W1-9/10 GRD
C6 4.7UF
C7 4.7UF
C8 4.7UF
C9 4.7UF
C10 4.7UF
C11 4.7UF
+5 A/R
GND A/R
RT
R6 33K SI
R8 33K (TYP)
F3
F2
F1
U3 8/1 SELECTOR
D0 D1 D2 D3 D4 D5 D6 D7
W2-16 Ø2
U9
U15
U19
R9 33K
R10 33K
+5
S1
B1
B2

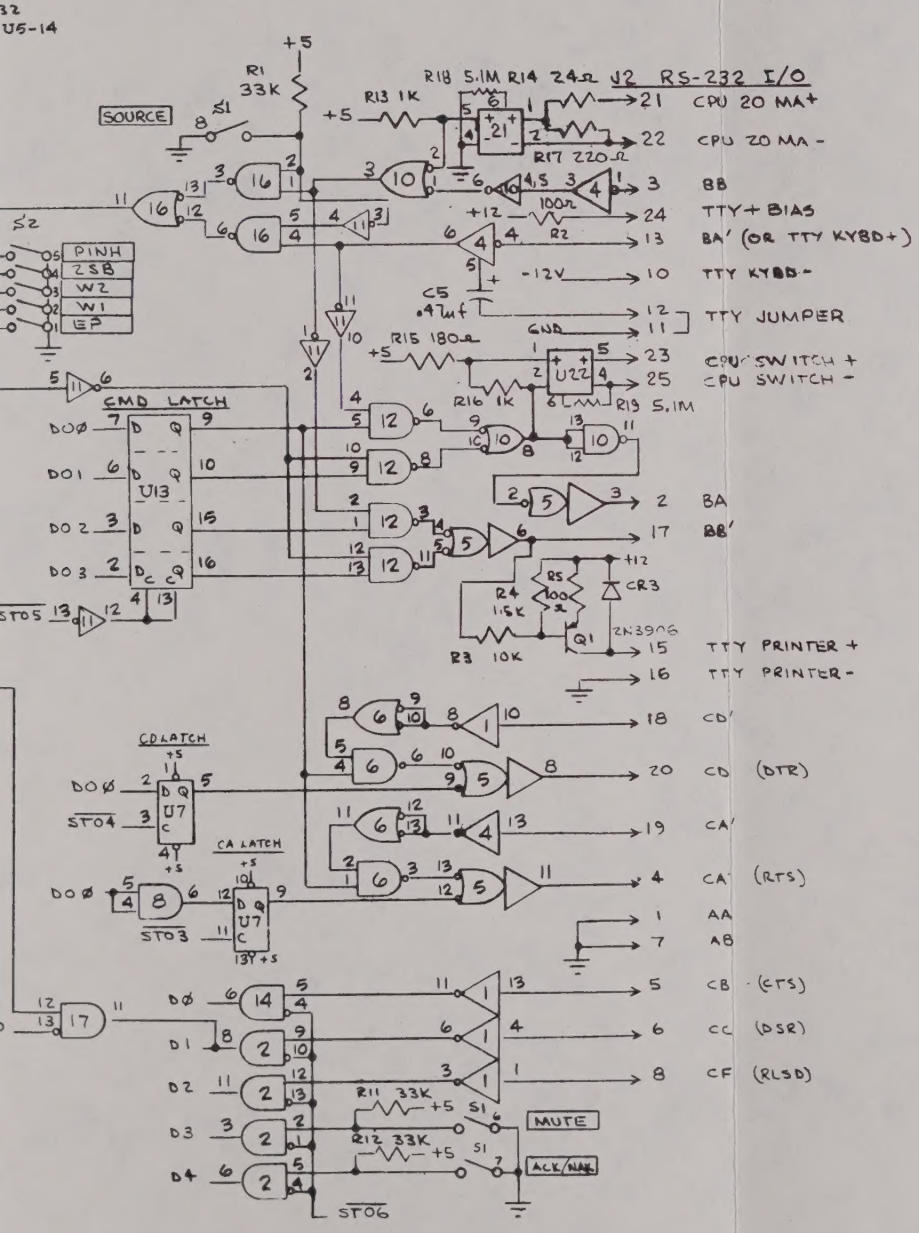


Figure 7-3 Model 4885A Serial I/O Card Logic Diagram